Metal Finishing

POLISHING AND BUFFING · BARREL FINISHING · CLEANING
PLATING · ANODIZING · RUST PROOFING · LACQUERING & ENAMELING

FEBRUARY, 1961

CONTENTS:

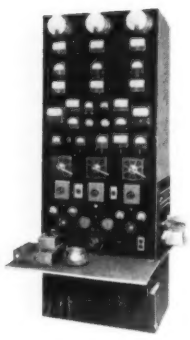
Read and pass on—

PLATING POWER BY DC POWER SPECIALISTS

Mathematical Design from Scripta Mathematica

DESIGN

is a big word at RAPID ELECTRIC



From the design board to the test board specialists are at work at RAPID.

Because RAPID specializes in dc power supplies and controls, each member of its staff is a specialist in his own right. Whether it is a design engineer or a trained technician each becomes integrated and woven into a highly skilled group whose main thought is dc power supplies.

That's why RAPID offers *so much more* in the way of dc power rectification. That's why RAPID units are distinctively different. (Your local distributor sells RAPID—call on him today. Name available upon request.)

RAPID ELECTRIC CO., INC.

2881 MIDDLETOWN ROAD • NEW YORK 61, N.Y. • TAlmadge 8-2200
PLANTS: (4) NEW YORK, N.Y. • GRAYSBRIDGE ROAD, BROOKFIELD, CONN.

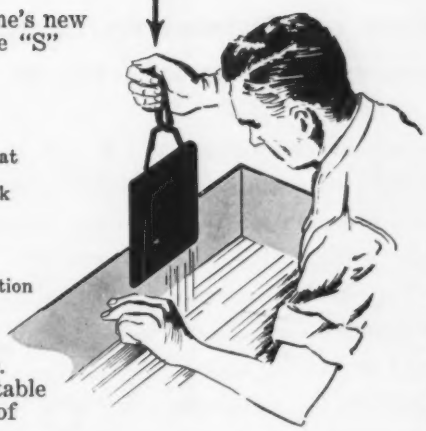
red smut?

not on this blackened steel

No red smut forms on any iron and steel parts when Enthone's new Ebonol Additive "S" is used in blackening baths. Additive "S" effectively holds in suspension dissolved iron and copper, preventing deposition of red smut on the work.

ADVANTAGES OF ADDITIVE "S" ARE:

- Eliminates red smut
- Produces deeper black
- Shortens blackening time
- Permits lower blackening temperature
- Increases production
- Improves ability of present baths to coat hard-to-blacken alloys
- Maintains corrosion resistance of black oxide coating
- Permits blackening of copper-brazed steel parts
- Costs less than other methods of controlling iron and copper contamination



Ebonol Additive "S" is used in all steel blackening baths which contain oxidizing agents and caustic soda and produce a coating in the 285°-305°F temperature range. It is a concentrated solution of blended complexing agents stable to oxidizing agents, high alkalinity and high temperatures of blackening baths.

Visual observation of the work is the only control required. At the first sign of red smut, add 1-2 ounces of Ebonol Additive "S" to each gallon of solution.

For complete information, write to Enthone, Inc., 442 Elm Street, New Haven 8, Conn.

ASARCO

ANOTHER PRODUCT OF *Enthonics* RESEARCH

ENTHONE

A Subsidiary of American Smelting and Refining Company

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ACCEPTED!

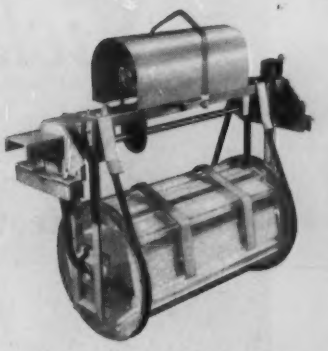
by the electroplating industry

as the most modern and most efficient equipment

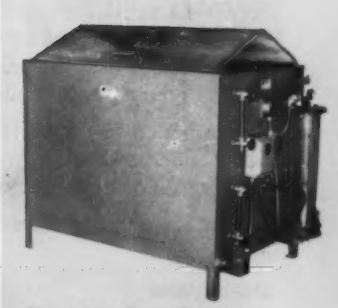
Albert Singleton
President

THE SINGLETON COMPANY

11770 Berea Road • Cleveland 11, Ohio
CLearwater 1-5580



Singleton Barrel



Singleton Corrosion test cabinet

Singleton is now considered the unchallenged leader with over 14 years experience. The country's top distributors rely upon them for:

- Singleton (O.E.M.) Barrels
- Singleton Barrel Tanks with exclusive inverted-V or horn saddle contacts.
- Singleton Replacement Barrels
- Singleton Corrosion Test Cabinets of plain steel, stainless steel or H-T Plexiglas.
- H-T Plexiglas Baskets and Buckets
- H-T Plexiglas Lab Tanks

All equipment is custom-designed to exacting specifications with the famous Singleton fusion-welded construction. For the highest quality at the most reasonable prices and fastest service, contact your nearest distributor or The Singleton Company direct.

It's Time to End the Confusion About Nickel Plating Processes

H-VW-M's New, Improved Levelume 220 is the Brightest Idea Among Today's Bright Nickel Baths

If you're confused, move over. So are a lot of other people in the plating business who are wading through the jungle of competitive claims.

H-VW-M takes the tiger by the tail in introducing Levelume 220—repeat Levelume 220—a bright nickel finish better than the original Levelume and ready to tackle any bright finish *production* job.

Levelume 220 is one of three new job-proved nickel baths offered by H-VW-M, each tailor-made to meet specific finishing requirements.

Let's consider the advantages and characteristics of each.

SUPERLUME

Superlume is the premium bright nickel, the ultimate in brightness building with leveling. Superlume is for those users who want tip-top performance to meet the finest possible finishing requirements and are willing to spend a little more for the very best. The cost difference often can be recaptured in total finishing costs.

LEVELUME 220

Levelume 220 is a modified Superlume and is the brightest, highest leveling nickel available *at no premium cost*. Levelume 220 features high brightness with uniformity of brightness on all surfaces, high tolerance to impurities, excellent leveling or scratch-hiding. Levelume 220 is truly the workhorse of all bright nickel plating processes, and meets the requirements of most high-quality bright nickel plating at moderate cost.

PERMALUME

Easy-to-operate Permalume is a sulfur-free, semi-bright leveling nickel process for dual nickel or duplex systems. It has been thoroughly production tested in commercial applications, with excellent results. The Permalume bath is stable and can be filtered continuously through a carbon pack to maintain constantly favorable plating characteristics. It does not require periodic stripping to remove degradation products. Permalume permits continuous operation . . . no downtime for bath purification and replacement of expensive addition agents removed by treatment.

Levelume 220 is an ideal top coating for duplex systems using H-VW-M's new semi-bright Permalume as a base coat. The Levelume 220-Permalume combination provides maximum corrosion resistance, compatibility, activity, leveling and stability. For duplex coating on diecastings and steel stampings, this combination of star performers is unbeatable.

Levelume 220 is the clear-cut answer to bright nickel plating *at no premium cost*. For information and technical help, call on H-VW-M.

Hanson-Van Winkle-Munning Company, Matawan, New Jersey.
Offices in Principal Cities.

Alert Supply Company is H-VW-M in the West.
Los Angeles • San Francisco

H-VW-M

Progress in metalfinishing through advanced processes • equipment

precise-production **ELECTROFORMING**

BARRETT SULFAMATE NICKEL has engineered reliability for:

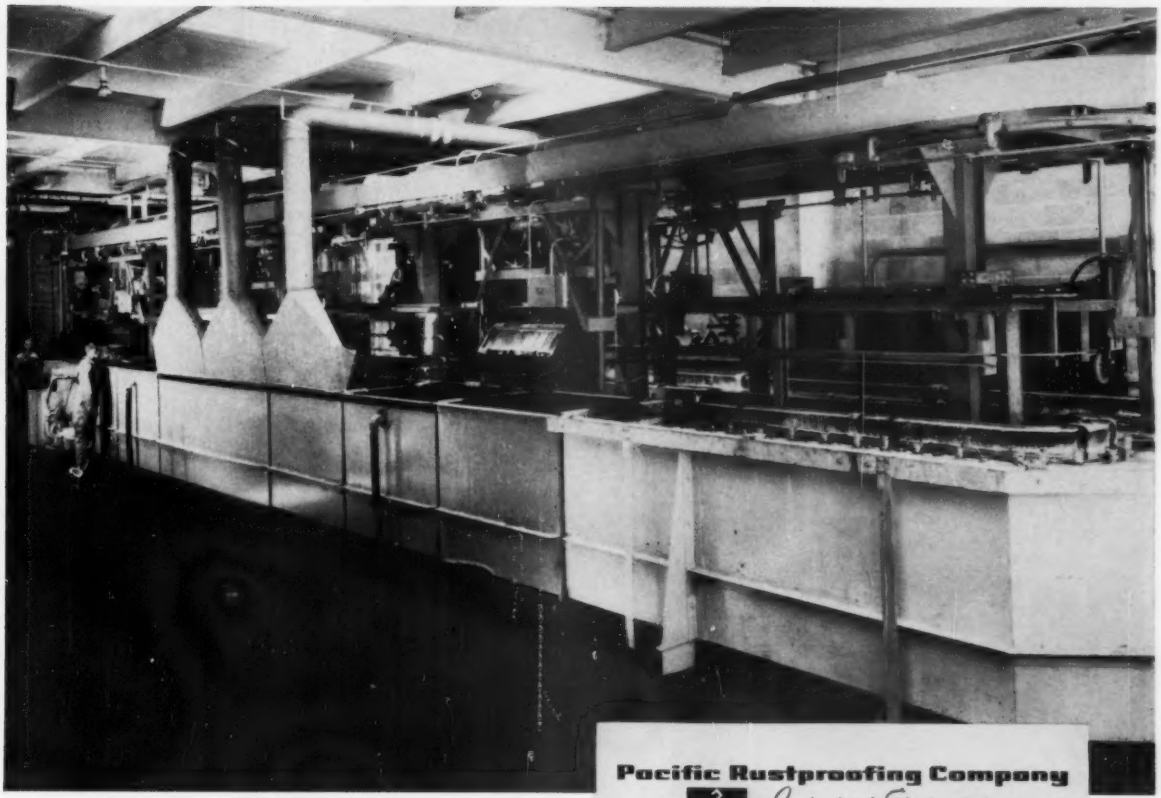
- exceptional low stress
- high speed deposition
- excellent machinability
- dimensional stability to thermal cycling
- less nodular growth
- superior throwing power
- excellent grain structure
- high chemical purity
- nickel to metal, glass, or ceramic bonding

BARRETT SULFAMATE NICKEL — a ready to operate process for heavy electrodeposition of nickel having exceptionally low tensile stress

Request Bulletin SN

Barrett Sulfamate Nickel on electroform mandrel indicating superior throwing power. Photo 500 x

BARRETT
chemical products company, inc. Shelton • Connecticut



Crown "MP" gets diversified zinc plating production out on time at low cost for Pacific Rustproofing Co.

Crown MP (Multi Purpose) is the most versatile of all automatic processing equipment for meeting the output and speed demanded in modern production. The key to "MP" versatility is an ultra-modern automatic programming and control system, of far advanced design. The "MP" can process several different jobs simultaneously; for example, two or three dissimilar metals can be plated in racks or barrels at two different voltages. The "MP" handles an astonishing range of sizes and weights . . . parts from ¼ inch to 40 feet; and from fractions of an ounce in weight to tons can be processed.

Besides helping to cut costs and meet production schedules, the "MP" improves product quality by precisely timing the processes.

If you have a continuous dipping process, find out what Crown Automation can do for you . . . write for Bulletin "MP" today.

Pacific Rustproofing Company

Industrial Electroplating

1735 PERALTA STREET • OAKLAND 7, CALIFORNIA • PHONE HIGATE 4-7333

Since 1956 this Crown "MP" Automatic Barrel Plating Machine has been in operation and doing an extremely satisfactory job of handling our daily zinc plating production. The variable time in the acid gives us the option of a mild or severe pickling and also the choice of either a clear or yellow chromate; these together with a variable zinc plating time enable us to process a wide variety of work. Processing specification work on schedule is an important factor in our operation.

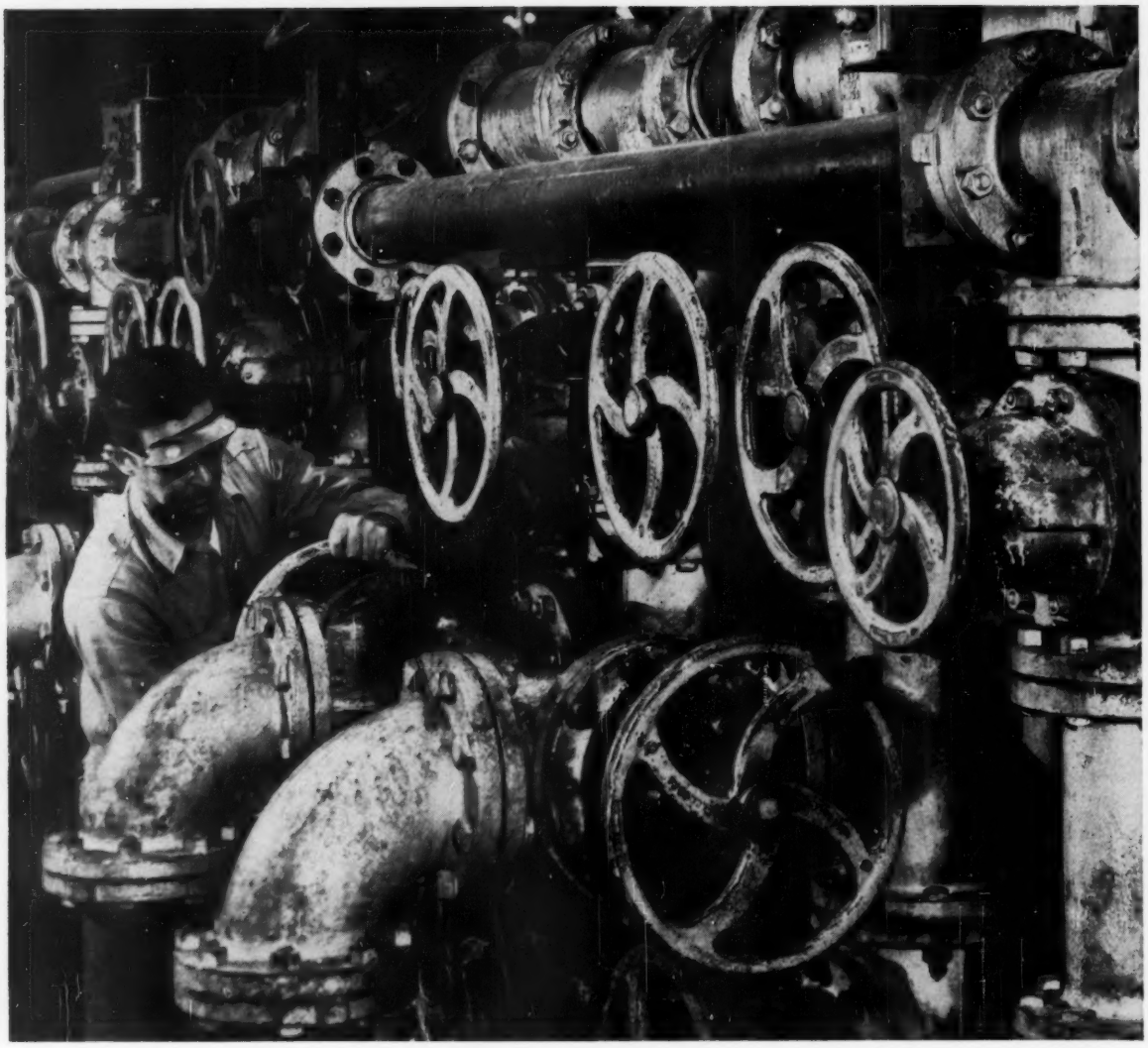
Pacific Rustproofing Co.

Robert A. Hart

Vice-President

CROWN

CROWN RHEOSTAT and SUPPLY COMPANY



SARAN LINED PIPE—only one short length replaced

after 8 years and 500,000,000 acid gallons

These Saran Lined Pipes and valves have carried 8300 gal./hour of hot acid plating solution . . . 24 hours per day, six days per week, for eight years. If they fail, the cost of production downtime is $11,000 *per hour*. In the entire 400-foot line, only two valves and a ten-foot length of pipe have been replaced in the eight years!

This piping complex feeds acidic solutions from heat exchangers to plating tanks in a large automotive plant. The solutions are circulated day and night, keeping the tanks at a required 160° F. A break in the line could also cause complete loss of the tanks' contents—at a cost of $8000, not counting downtime.

At the time of installation, many types of corrosion-resistant pipe were tested. Saran Lined Pipe was chosen as the permanent transfer medium for this operation for several reasons: extreme resistance to corrosion . . . high strength, requiring minimum support for horizontal runs . . . easy cutting and fitting without special equipment.

Whenever dependable piping systems are needed for corrosive material, consider Saran Lined Pipe. Saran Lined Pipe, valves, fittings and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can easily be cut, fitted and modified in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 1567CF2.

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

Cycleflex

FULLY AUTOMATIC
PLATER & ANODIZER

Conveyor Breakdowns Eliminated with new electro-mechanical control and safety device. Racks can't be pushed into sides of tank; load can't drop if power fails during work transfers.

Positive 6-Point Connections. Self-cleaning heavy duty contacts need little or no attention.

Rack Carriers Quickly Removed. A big time saver when servicing, or manually plating large pieces.

Fast Cycle Changes by shifting tank partitions and moving pick-up heads.

No Extra Headroom Required. All elevating mechanism operates below top of rack carrier.

Automatic Loading And Unloading of racks.

Delayed Set-Down to operate automatically with cycle. Furnished if required for conversion coatings and bright dips.

If More Than One Cycle is necessary, by-passing can be built in.

Hydraulic operation, standard.
Pneumatic operation, optional.

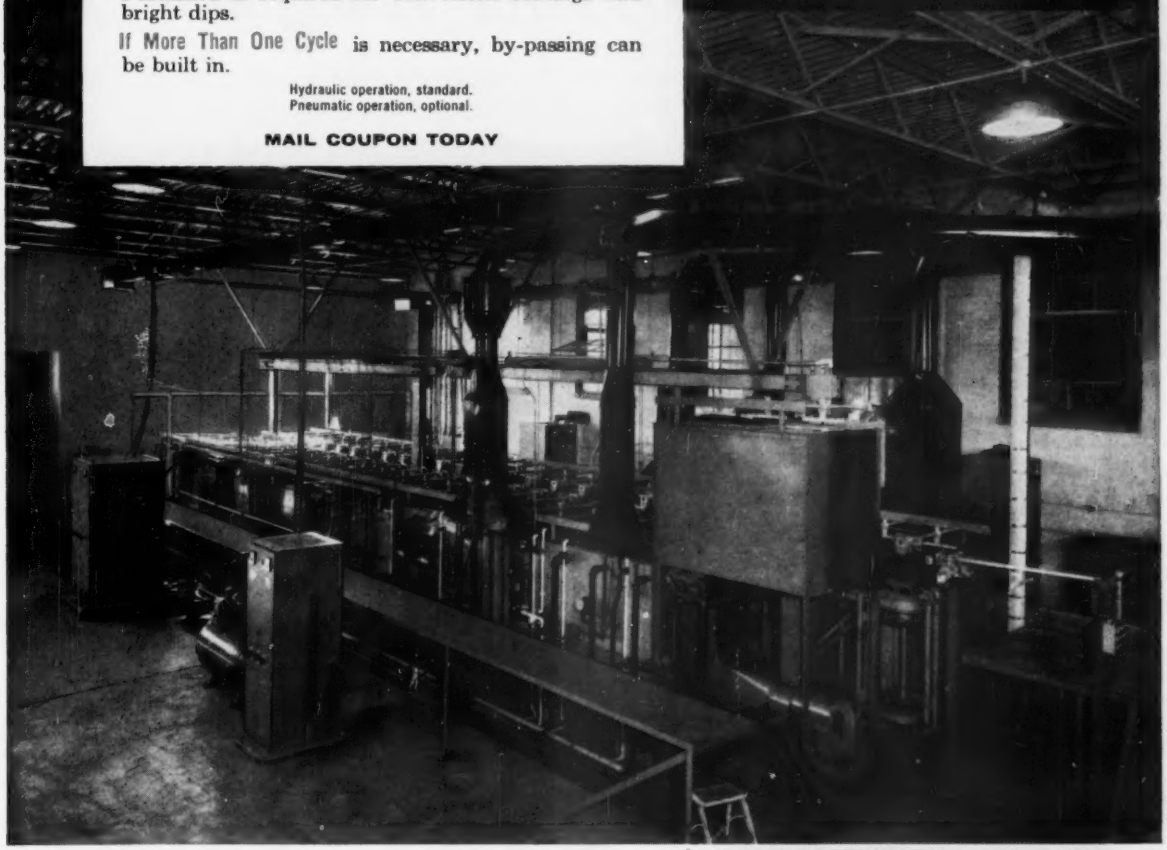
MAIL COUPON TODAY

ONE MAN

handles complete operation of this

MOST VERSATILE

OF ALL AUTOMATICS



LASALCO, INC.

HOME OFFICE: 2820 LaSalle St. • St. Louis 4, Mo. • PRospect 1-2990
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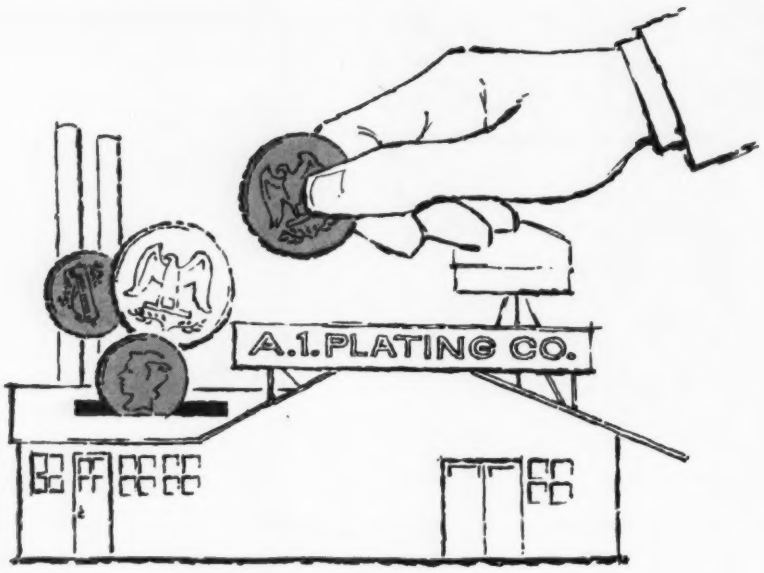
ATTACH TO COMPANY LETTERHEAD

Send complete information on fully automatic Cycleflex

Name.....

Title.....



EXTRA PROFITS for your plant

Customers satisfied with a high quality utility zinc brightener that costs you less? Then, your profit-wise choice is:

ROHCO® ECONOBRITE ZINC BRIGHTENER

Exceptional life. For plated parts where bright dipping after plating may be planned. Cannot be equaled in economy — with quality.

For customers who require greatest brilliance, the brightener that tops them all is:

ROHCO 100 BARREL ZINC BRIGHTENER

The champagne of all brighteners. 3-D depth for mirror-like finish. Highest covering power — substantial thickness of deposit in recesses usually unplated.

Both brighteners furnished in liquid. A winning team that will gain and hold the approval of your customers.

Arrange for a "show me" order through your nearest ROHCO Representative, now!

ROHCO

Nationwide Stockpoints

R. O. HULL & COMPANY, INC.

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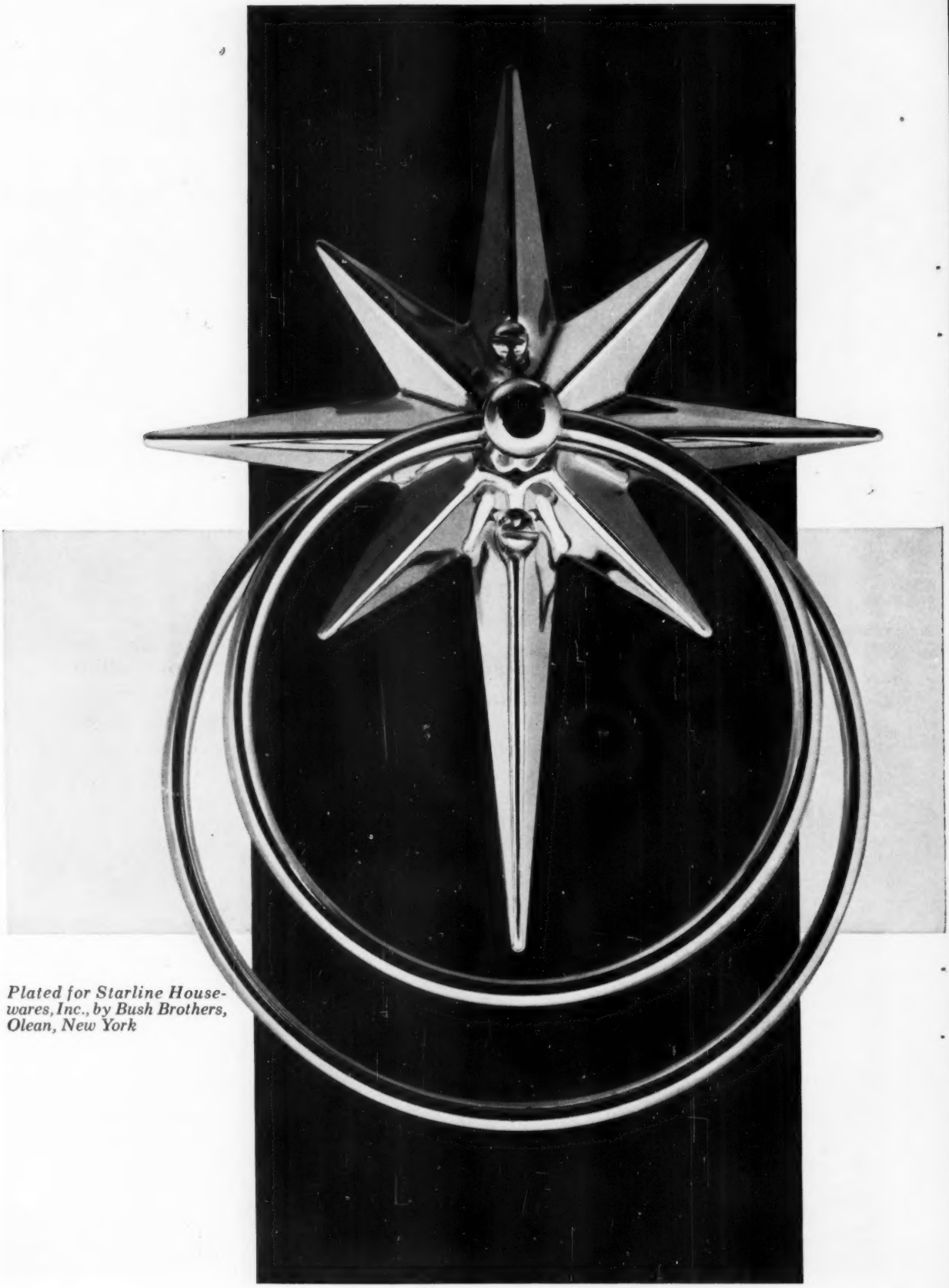
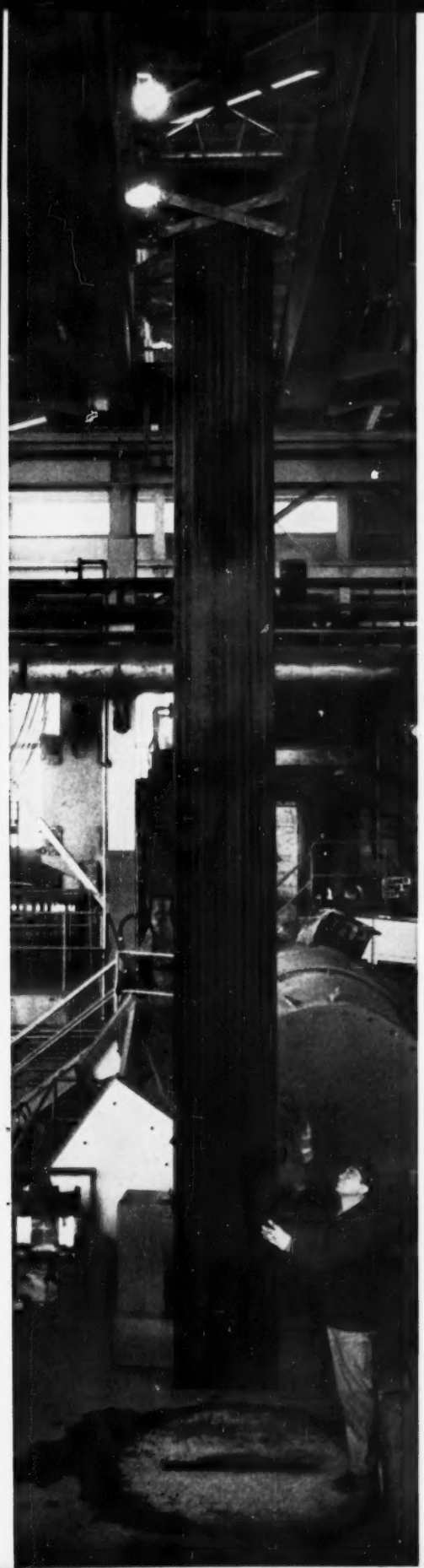
The RIGHT START . . . a BETTER FINISH



Plated for Starline Housewares, Inc., by Bush Brothers, Olean, New York



How close can you get to perfection in copper anodes?

Here you see the closest thing to perfect copper now available for electroplating purposes. This is the huge, void-free, dense cake of copper from which Asarco-Max copper anodes are cut. The patented Asarco process gives a grain structure so uniform that an inspection of Asarco-Max anodes in the plating tank, one by one, makes you think you are looking at the same anode each time you pull one out. Corrosion of the anode is uniform from the solution level down to the end, and this reduces scrap loss and down-time for anode replacement. Asarco-Max copper anodes will be cut to provide the length and weight you prefer. For additional information about our low-cost anodes, write or call Federated Electro-Chemicals Department, American Smelting and Refining Company, 120 Broadway, New York 5, N. Y.

ASARCO

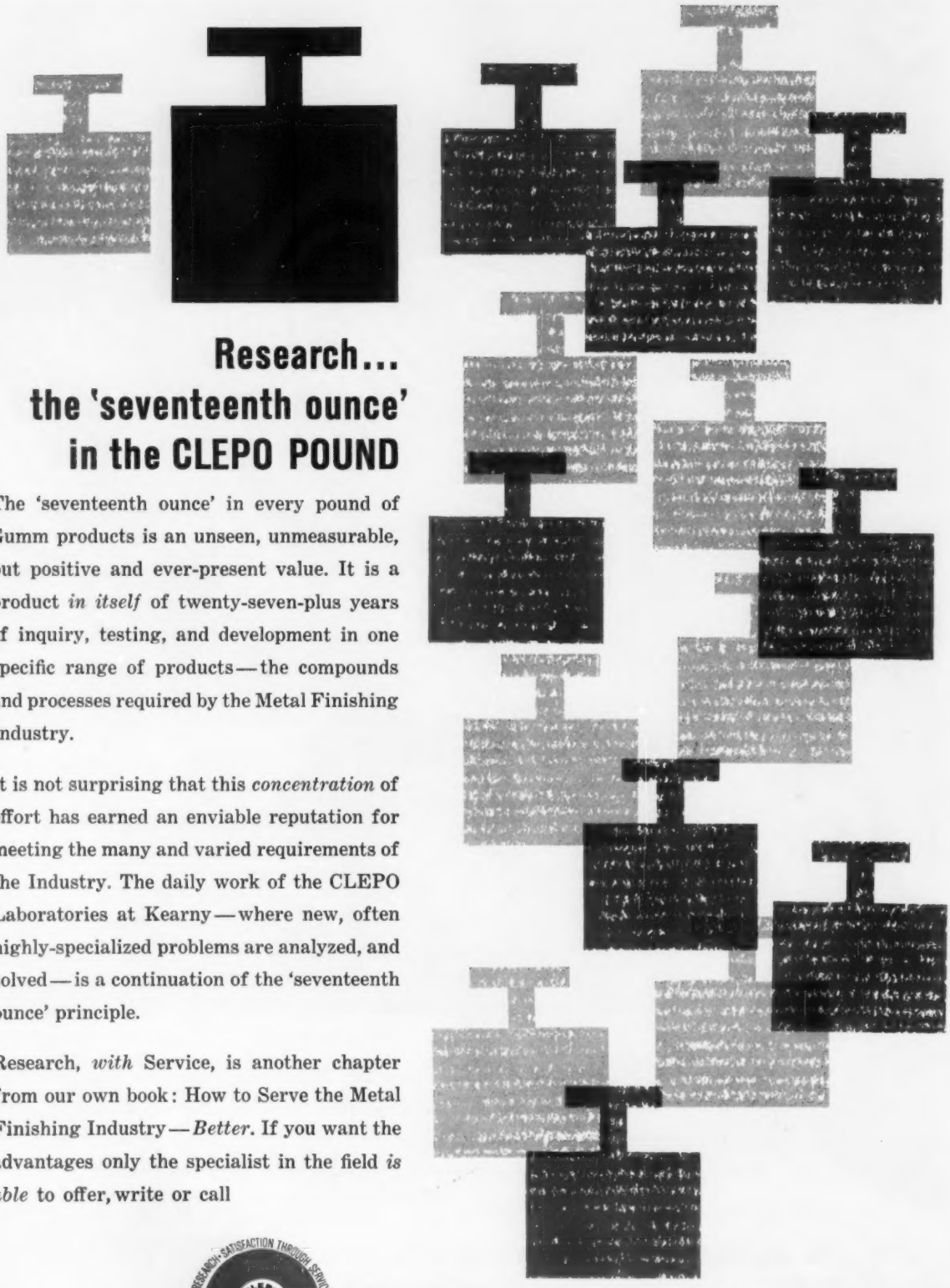
ASARCO-MAX ANODES

air compressors from DeVilbiss have greater finned cooling area, give you more air per power dollar. They're part of DeVilbiss' complete line of matched equipment for coating and finishing that includes: spray guns, automatic spray, dip and flow coaters, spray booths, air and fluid hose, ovens, spray washers, air-replacement units, dust collectors, complete "turn-key" finishing systems.

Talk to DeVilbiss about all your compressed-air needs thru 25 hp.

FOR TOTAL SERVICE, CALL
DEVILBISS

THE DeVILBISS COMPANY, Toledo 1, Ohio. Also Barrie, Ontario; London, England; São Paulo, Brazil. Branch offices in principal cities.



Research... the 'seventeenth ounce' in the CLEPO POUND

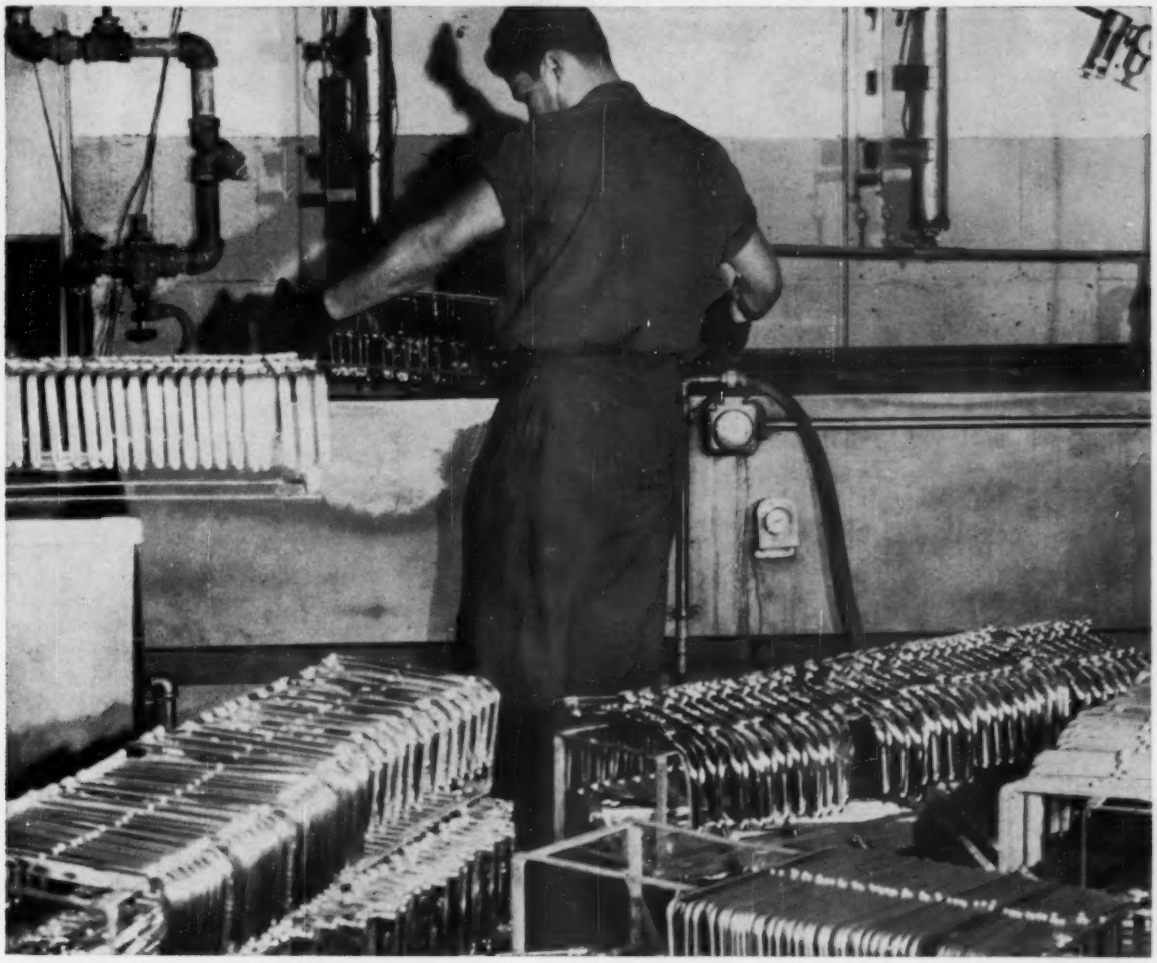
The 'seventeenth ounce' in every pound of Gumm products is an unseen, unmeasurable, but positive and ever-present value. It is a product *in itself* of twenty-seven-plus years of inquiry, testing, and development in one specific range of products—the compounds and processes required by the Metal Finishing Industry.

It is not surprising that this *concentration* of effort has earned an enviable reputation for meeting the many and varied requirements of the Industry. The daily work of the CLEPO Laboratories at Kearny—where new, often highly-specialized problems are analyzed, and solved—is a continuation of the 'seventeenth ounce' principle.

Research, *with* Service, is another chapter from our own book: How to Serve the Metal Finishing Industry—*Better*. If you want the advantages only the specialist in the field *is able* to offer, write or call

PROGRESS THROUGH RESEARCH • SATISFACTION THROUGH SERVICE
CLEPO

FREDERICK GUMM CHEMICAL COMPANY, INC.
538 FOREST STREET, KEARNY, NEW JERSEY



Metgal Novelty Company, Richmond Hill, L. I., degreases metal handbag frames.

302,400 PARTS BEFORE CLEANOUT

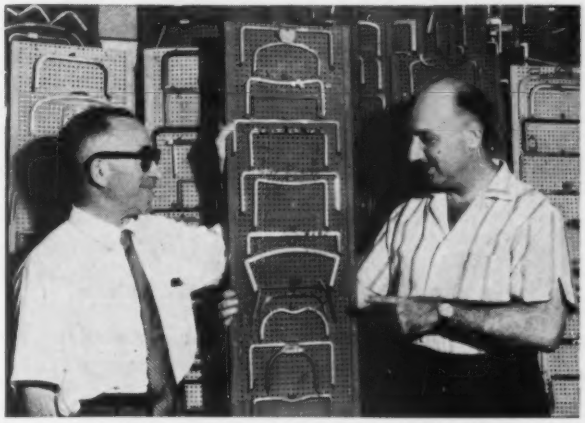
Metgal Novelty Company degreases thousands of metal handbag frames each week with Nialk® TRICHLORethylene.

It's not a simple cleaning job. Besides grease, they have to remove insoluble buffing compounds from the work. The metal might be brass, steel, plated copper or nickel plate.

The tanks "never go acid," says Sal Romano, co-owner. The stabilizer in Nialk TRICHLOR has *psp*—permanent staying power. It lasts, doesn't weaken between cleanouts. Since they get complete recovery of stabilizer on cleanout, they never have to add fresh stabilizer.

Regular tank checks are important to Metgal, too. Romano says, "Hooker and its local distributor, H. Harrington & Company, keep an eye on our operation so there is no undue loss of solvent."

Regardless of the metals you're working with, Nialk TRICHLOR can help solve your cleaning problems and save you money. Hooker's experience is yours for the asking. Call or write us about your problems or see your chemical distributor.



Henry Green (left), designer for H. Margolin & Company, leading handbag producer, and Richard Romano, Metgal co-owner, look over a display rack of handbag frames.

HOOKER CHEMICAL CORPORATION
1302 Union Street, Niagara Falls, New York

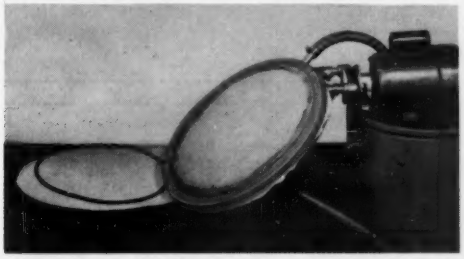
Sales offices: Buffalo Chicago Detroit
Los Angeles New York Niagara Falls
Philadelphia Tacoma Worcester, Mass.
In Canada: Hooker Chemicals Limited, North Vancouver, B.C.

HOOKER CHEMICALS PLASTICS

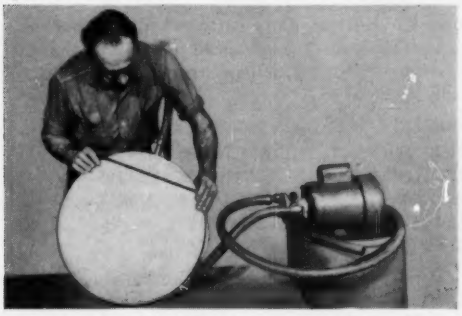
New BIG VOLUME in-the-tank FILTER

Combines practically continuous filtering, easy cleaning, convenience and low cost

BIG VOLUME: See the big flow of solution drawn through the filter and returned to the tank by the motor-driven pump.



SIMPLE: The big rubber band at the left of the illustration holds the filter paper in place.



EASY TO MAINTAIN: To replace filter paper just wet the paper, fit it in place and snap on the rubber band. Nothing could be simpler.

COMPLETE: The Filter sets in the solution. Motor-driven pump draws solution through the filter and returns the clarified solution to the tank.

LOW COST: The Filter and Pump is all you buy. Costly tanks, valves and piping are not needed.

UNIVERSAL: Moves from tank to tank. You can easily move from one end of the plant to the other; also set aside when not in use.

NO INSTALLATION EXPENSE: Just put the filter and the discharge hose in the tank and plug in the pump motor—that's all.

NO FILTER AID REQUIRED: Remarkable new filter paper does the complete filtering job.

BIG FILTER AREA: 3½ square feet.

EASY TO CLEAN: Put the filter in the drain and flush it clean with the hose. Anybody can clean the filter and have it back in operation in seconds.

UNLIMITED CAPACITY: You need not be handicapped for lack of filtering capacity. Just add another Model B In-The-Tank Filter. Set it aside or use it in another tank when not needed.

Filtering can prove a big time and money saver. Write for particulars, NOW.

BELKE Model B In-the-tank Filters can be furnished for practically all types of acid or alkaline plating solutions. *Please specify the type of solution to be filtered when ordering or requesting quotation.*

BELKE MANUFACTURING COMPANY
947 N. Cicero Ave., Chicago 51, Ill.
EVERYTHING FOR PLATING PLANTS

METAL FINISHING: YOUR BEST SALESMAN!

Because ... since 1903 —This publication has been recognized as the engineering authority on finishes and the finishing of metals and plastics, and is read by top executives in charge of finishing operations and/or departments —who pay for the privilege. There is no waste circulation! The key buying power in the finishing industry asks for and reads METAL FINISHING on a voluntary paid circulation basis.*

Because METAL FINISHING'S paid subscribers enjoy and absorb the editorial content which is geared to their needs and balanced between the theoretical and the practical; plus the annual GUIDE-BOOK-DIRECTORY which contains 754 pages of technical "know-how" and "where-to-buy" finishing supplies and equipment.

Because METAL FINISHING is a full 7x10 page size authoritative technical magazine which covers both organic (painting, etc.) and inorganic (plating, etc.) finishing processes—offers complete service to advertisers and prospects by providing detailed and valuable market studies relating to all aspects of the finishing field, such as the above breakdown of types of operations performed in 42,477 departments in both captive and contract shops engaged in the finishing of metals and plastics.

Write for our new market data file which contains a list of jobbers and distributors in the metal finishing field, information on our mailing service, rates, geographic breakdown of the industry, etc.

*$5.00 in U.S. and Canada; $15.00 Foreign

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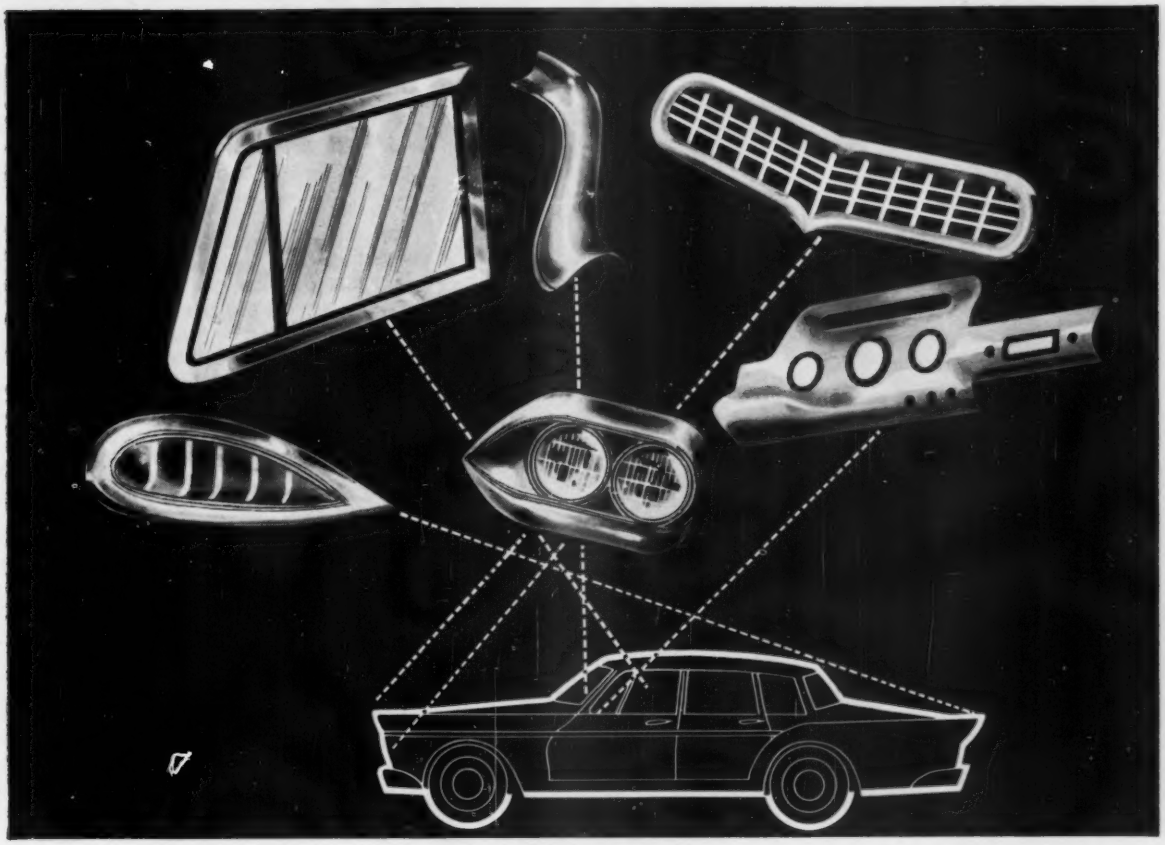


Aluminum adds the bright touch

"Bright dip" aluminum parts and trim bring a high note of glamour to the graceful lines of modern automobiles. Practical, easily-formed aluminum appears as mirror-bright radiator grilles, body trim, window molding, light bezels, and a growing list of other parts.

"Bright dipping" is a chemical polishing process that dissolves the microscopic high points of a metal's surface faster than its low points. Thus, a few minutes' dip in the solution smoothes and thereby polishes aluminum parts to a high lustre. Then they are anodized for protection against wear and corrosion. This unique polishing process—also used with copper, brass and stainless steel—is becoming part of the manufacture of a long list of products extending from automobiles to zippers.

The major ingredient in "bright dip" solutions is phosphoric acid, one of the many phosphorus chemicals produced by Virginia-Carolina Chemical Corporation. V-C Phosphoric Acid, made from elemental phosphorus from V-C's own phosphate mines, is known for outstanding quality and purity. All three grades exceed American Chemical Society, National Formulary, and Food and Drug Regulations requirements where applicable.

V-C Phosphoric Acid	85% N.F. Grade	80% Food Grade	75% Food Grade
Sp. Gr. (20°/4°C)	1.691	1.635	1.581
Lbs./gal.	14.1	13.6	13.2
P_2O_5	61.71%	58.08%	54.50%
H_3PO_4	85.21%	80.20%	75.26%
Cl	0.0001%	0.0001%	0.0001%
Fe	0.0002%	0.0002%	0.0002%
Pb	0%	0%	0%
As_2O_3	0%	0%	0%

FREE BOOKLET "Bright Dip Hints" and samples available. V-C specialists, drawing on years of "bright dip" experience, are happy to give you detailed information in terms of your own operation. Write today!

Virginia-Carolina Chemical Corporation • Chemicals Division
401 East Main Street, Richmond 8, Virginia • Phone: Milton 8-0113

V-C® Phosphoric Acid

Now Ready For Distribution

METALLIZING OF PLASTICS

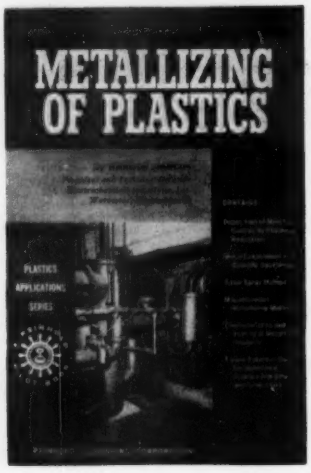
by **HAROLD NARCUS**

President and Technical Director, Electrochemical Industries, Inc.

1960, 208 pages, 55 illustrations, $5.50

COVERS DETAILS OF EVERY COMMERCIAL PROCESS

THIS EAGERLY AWAITED BOOK presents complete details for carrying out every commercial metallizing process for plastics or other nonconductors. It is the first treatment of the subject that deals with *actual production procedures, formulations* and *techniques* for all known metallizing methods. These include the copper film process (developed by the author), the deposition of "electroless" nickel coatings, a review of the new molded conductive plastics, "gas" plating, the deposition of thick evaporated films and many, many others. The text is replete with illustrations showing the latest equipment being used in the newer processes. Recent advances receive special attention, particularly in the final chapter. This chapter contains developments as recent as a few months ago.



Much more than a bibliographic source, this book is essentially a metallizing manual for the plastics, electronics and electroplating industries.

CONTENTS

Deposition of Metallic Coatings by Chemical Reduction • Vacuum Metallizing • Cathode Sputtering Process • Silver Spray Method • Miscellaneous Metallizing Methods • Characteristics and Testing of Metallized Deposits • Future Potential Uses for Metallized Plastics and Other Nonconductors • Bibliography • Index

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METAL FINISHING

381 Broadway, Westwood, New Jersey

The New STUTZ Plating Barrels

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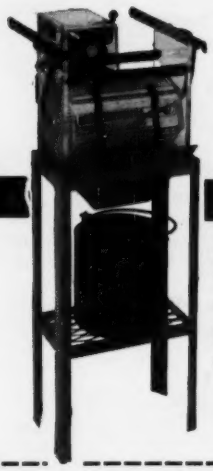

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BRANCH OFFICES

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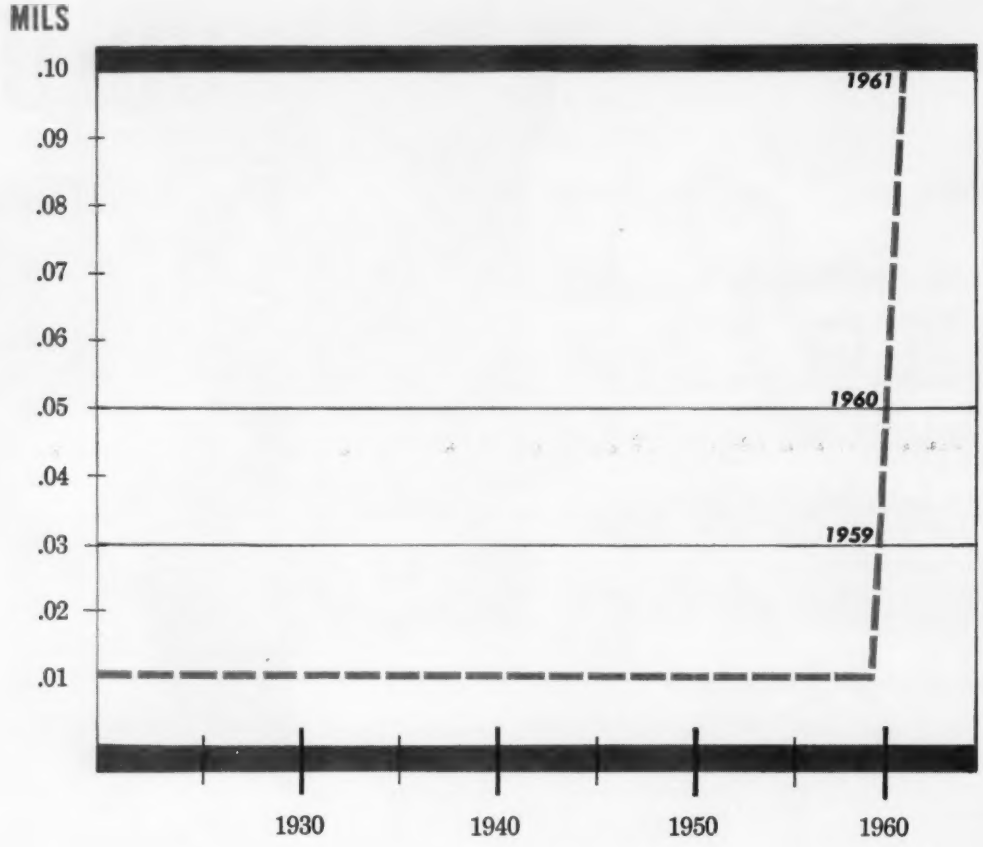

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PRIDE OF WORKMANSHIP

For more years than we care to count, we've been pounding on the subject of better quality, at least for the good of our industry, if not for the consumer. The years immediately following the conclusion of hostilities were a period during which satisfaction of the pent-up demand for civilian products of every kind taxed the production facilities of all industry. In a seller's market, quality often is left standing by the wayside because the temptation to make an extra dollar has a tendency to overcome concern for a product's reputation. Of course, there was the excuse of material shortages but, in too many instances, this turned out to be an excuse, not a reason.

Lately, some chickens have been coming home to roost; the public has developed an understandably skeptical attitude toward the protestations of manufacturers as to their high-minded concern for the common weal. This "show-me" approach makes it more difficult for the reputable producer, who is smeared with the same indiscriminate brush. It has been gratifying to note the steps taken to build quality into new products, but convincing the public is going to be only part of the job. Labor will have to be sold on the idea of quality also.

Pride of workmanship is a phrase which is no longer restricted to the vocabulary of management; it is getting out into the open. As a couple of examples, the editor has noted its use by widely-read columnist Ed Sullivan, and best-selling author, Alexander King, has remarked that pride in one's work is disappearing out of our world. One of the unfortunate aspects of mass production has been the alienation of the worker from the *whole* job. Performing a monotonous, mechanical operation of practically no significance, how can the worker be proud? Proud of a tight bolt? But, his employer's reputation may hinge on the bolt being tight!

In the old days, a man made the whole shoe or coat, and the finished product was his work, and his only. *He* had something to be proud of. There was once a time when a polisher headed-up his own emery wheels, polished the batch, cut down and color-buffed the surfaces, and could be proud of the finish. Sometimes, he even did his own plating! Tending an automatic polisher, plater, or painting machine offers nothing in the way of satisfaction to the operator for a job well done. And, when this is the case, carelessness and disinterest must be the rule rather than the exception.

Ways must be thought up to interest the worker in his work because, without this interest, all other attempts to improve quality will go for naught. According to Veblen, pride in workmanship was brought about by Eve. Has it persisted for millenia only to die out in our generation?

Nathaniel Hall

Evaluation of Electrodeposited Coatings

By Lester F. Spencer

THE evaluation of an electrodeposited coating is normally made in the course of fundamental research, or for control purposes either in development or production. This evaluation may be obtained by selecting one or more accepted procedures although, in some instances, their reliability and/or reproducibility may be questioned. In contrast to these standard test procedures, which usually require specialty equipment and give a qualitative evaluation of a property, mention should be made of the practical tests made by the average plater, which give a qualitative evaluation. These, exemplified by the "chisel and hammer test for adhesion," are not recognized as a standard test.

A variety of test procedures are available to evaluate a specific property such as porosity, adhesion to basis metal, flexibility of coating, wear and abrasion resistance, coating thickness, etc. Where the test procedure is selected for production control, the choice of test is not too significant, provided that the test procedure has been proven by experience as to its reliability and reproducibility. If the test procedure is selected as an acceptance condition, a more selective choice of test procedure is required; this selection is usually made by mutual consent. It is also well to report both the test employed and the results obtained, since various tests of a given property may not give comparable results.

Although a detailed discussion on the evaluation of metallic coatings under service conditions will not be included, it may be stated that an evaluation such as this is quite complex. Not only is it necessary to consider production variables, but also, the electroplater is at the mercy of the consumer in that the product is exposed to a variety of and, unfortunately, unpredictable corrosive environments. An attempt to evaluate the serviceability of a metallic coating is effected in the form of time-consuming and costly, atmospheric and simulated immersion testing. More frequently, the serviceability of a coating is obtained through actual experience, usually through the media of field failures, customer complaints, and periodic service reports from field engineers. In the event that premature breakdown is experienced, the gradual accumulation of corrosion data will lead to product improvement and development of new techniques. Where the coating has given excellent service, a degree of confidence is established as to the selection of the metallic coating.

It is a generally accepted fact that an electrodeposited coating of a relative simple shape, such as sheet, strip, rod, and wire stock, has an inherently high uniformity and all that may be required to assure quality is a periodic evaluation of the average coating thickness. On the other hand, in the evaluation of a coating on a fabricated item, particularly where the design may include recessed areas, the distribution of this coating will be of more importance. Also, if specified areas of a fabricated part require a maximum coating thickness due to anticipated greater wear, erosion, or chemical attack, it may be necessary to tailor the test procedure in the evaluation of these critical areas.

Besides evaluation of average coating thickness and distribution, the more important properties that are evaluated include (a) porosity, (b) adhesion, (c) ductility, (d) hardness, and (e) appearance. A good portion of the tests employed have been incorporated in standard specifications, each test procedure having certain limitations and disadvantages. Accuracy of the results thus obtained will be influenced by those errors inherent within the procedure, and those conditions within a specified plant such as the type of metallic coating, basis metal analysis, deposit thickness, equipment type, operator technique, etc.

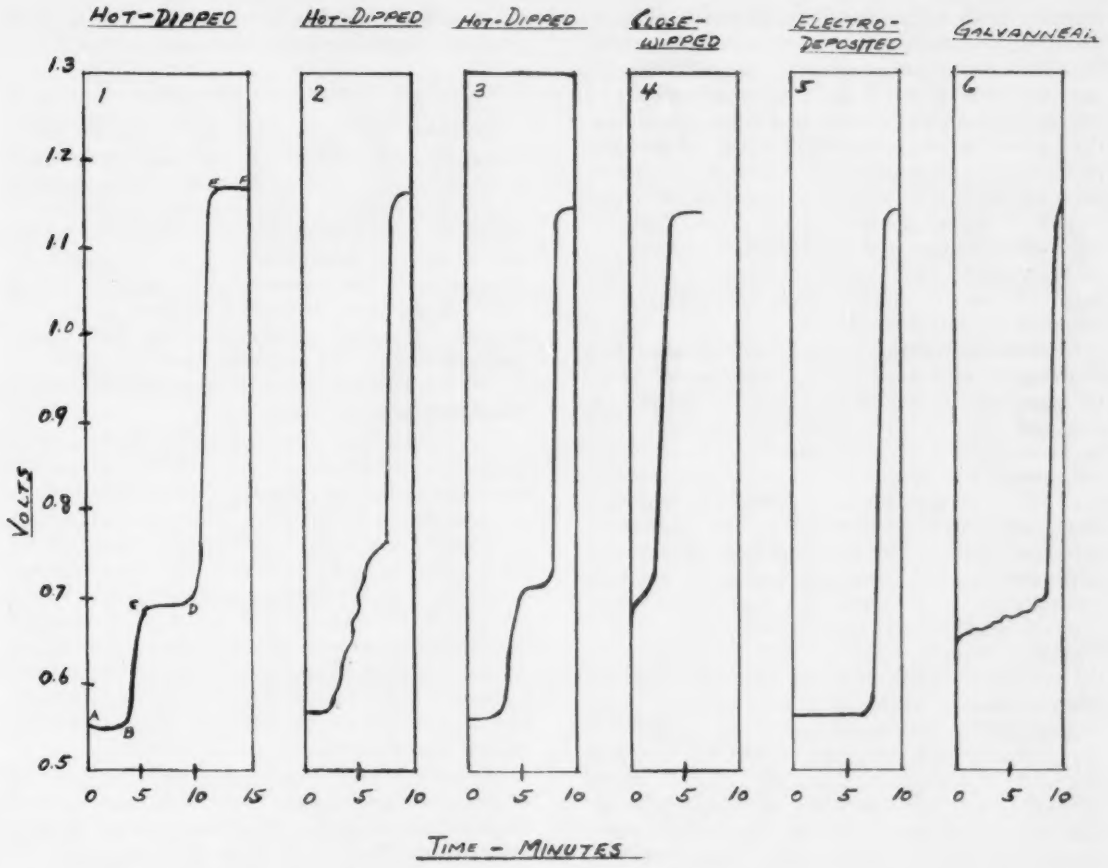
Thickness of a Deposited Coating

The measurement of coating thickness is, by far, the most frequently performed test. The reason for its popularity is the accepted fact that the protective value of a coating, particularly that of zinc and cadmium deposits on steel, is nearly proportional to the thickness of deposit. This linear proportionality is not present on metallic coatings of copper, nickel, chromium and silver on steel,[3] since coating porosity decreases with increased thickness of coating. Thus, there is an optimum thickness and any further increase will follow the law of diminishing returns. Both average and uniformity of coating thickness will be considered.

AVERAGE COATING THICKNESS:

This is frequently determined by a chemical stripping technique, the accuracy in measurement being proportional to the accuracy with which the weight of deposit and the plated area are measured. Other procedures that will be considered include (a) electrolytic methods which may yield information on both coating thickness and structure; (b) magnetic procedures[4,5] which provide a rapid and non-destructive type test; (c) radiation back scattering;[6] (d) coulometric analysis;[7,35] (e) electronic thickness gauging;[8] and, (f) metallographic techniques.

In a discussion of *chemical stripping*, hot-dipped



zinc coatings will also be considered. The more common shop practice employed on galvanized sheet involves coating a pickled and washed sheet of known weight and dimensions[14] and, after a suitable draining period, the sheet is reweighed. The hydrochloric acid-antimony chloride method[9] is standard for both zinc and cadmium coatings. It is also used to some extent[10] in determining the thickness of tin coatings on steel; a thickness of 0.0001″ requires about one minute for solution of the coating. Alternate chemical stripping solutions include (a) 1:1 aqueous solution of hydrochloric acid for zinc coatings: (b) the sulfuric acid metnod[11] used to distinguish hot-dipped zinc coatings from electrodeposits; (c) the basic lead acetate method,[12] also applicable for zinc-coated items; (d) the alkaline iodate method[13] for stripping tin plate; and, (e) the ammonium nitrate solution[14] and the ammonium persulfate-ammonium hydroxide solution[2] for stripping cadmium plate.

The sulfuric acid method will exhibit an iron-rich solution at the end of the test when applied to hot-dipped coatings, whereas, the solution will be clear when used in stripping electroplated coatings. This test will also determine the presence of lead in a hot-dipped coating since this element will form an insoluble product. The lead acetate method is based on the electropositive nature of lead to zinc. It is not recommended for coated articles of irregular shape, due to the inability to remove precipitated lead from crevices and re-entrant angles.

Since *electrolytic procedure* accuracy is dependent upon maintenance of a uniform current density, it is not recommended for non-symmetrical shapes. An aqueous solution of sodium chloride-zinc sulfate has been recommended[15] for zinc-coated wire products. A 10% solution of potassium cyanide[16] is also satisfactory. Of interest is the use of this method in evaluating phase structure by observing the anodic potential over the time period required for stripping.[15,17] This is illustrated in Figure 1 which clearly distinguishes between a hot-dipped and electrodeposited coating of zinc. Referring to portions of this curve, the section AB on curve 1 represents the potential of pure zinc; at CD, the potential of the iron-zinc alloy layer is indicated and, based on the length of this portion of the curve, this alloy layer is of considerable magnitude; and, AE represents the potential range of the entire coating. Both curves 2 and 3 may be interpreted in two ways, either the alloy layer is relatively thin or a non-uniform coating is present. Curve 4 illustrates the reduction of coating thickness that is obtained by close wiping a zinc coated wire, whereas, curve 5 illustrates the complete absence of the alloy layer in an electrodeposit. Curve 6 indicates that substantially all of the coating is converted to an alloy phase by annealing.

Magnetic methods involve a measurement of an attractive force between the specimen tested and a standard magnet.[20] Typical equipment types have been described in the literature and are available from a number of sources.[5,18,19,21] For non-magnetic deposits on

magnetic basis metals, the force of attraction is reduced proportionally to the thickness of the deposit. For nickel deposits on a magnetic basis material, this attractive force is also reduced but to a lesser extent, whereas, with a nickel deposit on a non-magnetic base, the force of attraction is proportional to the thickness of the deposit. This testing procedure will realize an accuracy between 85 and 90% depending upon both the type of deposit, basis metal and deposit thickness. The greatest limitation of this method is its restriction to appropriate combinations of magnetic material[29] and, to a lesser extent, its general sensitivity to both vibration and surface roughness.

Coulometric analysis[7,35] is suitable for electrodeposited coatings of nickel on steel, chromium and nickel on copper, and chromium on nickel. This method has also been used to some extent[14] in determining the thickness of zinc, cadmium, and copper on steel. The cell construction, using a 10% solution of sodium hydroxide as the electrolyte for tin, lead, zinc, and chromium, and a 10% solution of potassium cyanide for cadmium, copper, silver, gold, and brass, is described in the literature.[7,35] The endpoint in an automatically controlled unit is indicated by a sharp current drop. It is well suited for very thin electrodeposits.

Other methods include: (a) radiation back scattering procedure,[6] which is a non-destructive test particularly adapted where the atomic numbers of the coating and the basis metal are sufficiently different; (b) electronic thickness gauge,[8,29] which is also non-destructive and employed where the conductivities of the coating and basis metal are sufficiently different. This method is versatile in that both metallic and non-metallic coatings on metals can be determined. It is also used[29] for metallic deposits on non-conductors; (c) metallographic examination, which has the added advantage in that distribution of coating as well as coating structure can be evaluated. X-ray,[20] electron diffraction,[3] and density procedures[22] have been used to a minor extent; the latter procedure is particularly suited where the specific gravity of the basis metal is quite different from that of the coating.

Uniformity of Coating

The oldest and most widely known test for determining the uniformity of coating is the Preece test,[23] designed for zinc coatings. The test actually measures relative distribution[24] rather than actual thickness of deposit at a given point. The general procedure consists of alternate immersions in a neutral copper sulfate solution for one minute intervals until an adherent copper is deposited. Difficulties involved in this test have been evaluated, usually concerning the accurate determination of the end-point, particularly in hot dipped zinc coatings where the alloy layer interferes, and in very thin electrodeposits.[24,25]

The *spot tests* are more applicable. One procedure involves the use of concentrated hydrochloric acid for decorative chromium deposits. The thickness[3,27] is measured by the time required for one drop of acid to completely dissolve the coating. The accuracy of the test is stated[3,29] to be between 10 and 20 percent and is usually limited to deposits of 0.00006″ and less in thickness.[36] The chromic acid spot test[26] is used for zinc deposits. Successive drops of the solution fall on the test sample at 15 second intervals with subsequent removal of each drop with absorbent cotton. The thickness is measured by the number of drops that is required for perforation.

The development of the *dropping test* is based on the observation[2] that the rate of solution is more constant if the solution is applied in successive drops. As indicated in Table 1, various reagents have been proposed, usually for zinc, cadmium, tin, and copper. Essentially, the test consists of using an appropriate reagent and allowing it to drop on the test surface at a controlled rate; the thickness measurement being based on the time required for penetration.

The *jet test*[33,34] is similar to the drop test with the

TABLE 1. ***Reagents Used in the Drop Test***

Reagent	*Comments*	*Ref.*
Iodine, 100 g./l. Potassium iodide, 200 g./l.	Under conditions of test, 18 drops required for dissolution of 0.0001″ cadmium, and, 22 drops for the same thickness of zinc.	29 28
Ammonium nitrate, 100 g./l. Conc. nitric acid, 50 ml./l.	For electroplated zinc. Each second is equal to 0.00001″ of coating.	29 30
Ammonium nitrate, 100 g./l. Hydrochloric Acid, 75 ml./l.	For hot-dipped zinc coatings. Each second equal to 0.00001″ of coating.	2 29
Ammonium nitrate, 100 g./l. Hydrochloric acid, 10 ml./l.	For cadmium. Each second equal to 0.00001″ of coating.	29
Chromic acid, 200 g./l. Sulfuric acid, 50 g./l.	For both zinc and cadmium coatings. Each second equal to 0.00001″ of coating.	14 29
Trichloroacetic acid, 100 g./l.	For tin deposits. Each second equal to 0.00001″ of coating.	29
Ferric chloride, 450 g./l. Antimony trioxide, 20 g./l. Hydrochloric acid, 200 ml./l. Glacial acetic acid, 250 ml./l.	For copper deposits. Two seconds equal to 0.00001″ of coating.	29

Note: Thoroughly clean sample. Hold specimen at an angle of 45 degrees below the dropping tip. Clamp section tested so that reagent hits the same spot during test. Dropping rate 90 to 110 drops per minute; temperature 70-90°F.

TABLE 2. *Reagents Used in Jet Test*

Reagent	*Comments*	*Ref.*
Ferric chloride, 300 g./l. Copper sulfate, 100 g./l.	For nickel, cobalt, copper, and composite coatings of nickel and copper.	14 37
Ammonium nitrate, 17.5 g./l. 1N Hydrochloric acid, 17.5 ml./l.	For cadmium coatings.	14
Ammonium nitrate, 70 g./l. 1N Hydrochloric acid, 70 g./l.	For zinc coatings.	14
Trichloroacetic acid, 100 g./l.	For tin coatings. This solution diluted to half strength is suitable for tin-zinc alloy coatings.	14
Potassium iodide, 240 g./l. Iodine, 7.44 g./l.	For silver deposits. The iodine solution must be standardized against sodium thiosulfate to contain exactly 7.44 g./l. iodine.	29 38

Note: Thoroughly clean sample. Hold specimen at an angle of 45 degrees below the dropping tip. Clamp specimen so that the reagent hits the same spot during test.

exception that the reagent is applied in a continuous fine stream and is applicable[14] for nickel, copper, bronze, zinc, cadmium, tin, cobalt, tin-zinc alloy, silver, and lead deposits on steel, copper, brass, aluminum, and zinc-base metals.[38] The more prominent reagents are tabulated. Ordinarily, since the end point cannot be seen while the solution is flowing, the specimen should be examined after each application of the jet. The time for penetration of the coating is obtained and, as in the dropping test, the coating thickness can be obtained by the use of a calibration curve. Standard calibration curves are cited in ASTM Standards, Part 3.

As in other forms of test procedure, accuracy of the test is dependent upon the endpoint. Using the ferric chloride-copper sulfate solution given in Table 2, Clarke[37] stated that nickel on steel will show a copper spot only after the flow has stopped for a few seconds; nickel on copper will show a coppery spot that is immediately evident; nickel on brass will have a brownish spot with the basis metal somewhat discolored; nickel on aluminum will have a central black spot and, frequently, a halo of copper; and, nickel on a zinc alloy will also show a black spot similar to that for aluminum.

A correction factor may be required when testing bright nickel; Hodges[29] has given a correction factor of 1.5, whereas, Edwards[39] has indicated that the correction factor will depend on both the organic bright nickel being tested and the coating thickness. Such[40] has suggested that separate calibration be performed for each type of deposit tested; however, this will be time-consuming and will virtually eliminate the utility of the jet test as a production control procedure. The structural characteristics of the deposit may also influence its behavior; thus, Read and Thompson[44] demonstrated that variations of internal stress will influence the results obtained in the jet test.

The *chord method*[42,43] may be used to some extent; however, there may be some difficulties in recognizing the interface between the coating and the basis metal. The procedure consists of cutting through a coating exactly to the interface on a curved surface with a flat file or, on a flat surface, with a precision grinding wheel. The thickness is $C^2/8R$ where C is the chord width and R is the radius of the surface or wheel. Accuracy is dependent on technique; however, it is claimed[3] that evaluation may be made within 10% on coatings down to 0.2 mils.

Porosity Test Procedures

When a metallic coating is cathodic to a basis metal such as steel, the coating will corrode less readily than the basis metal. This will mean that, where discontinuities or pores are on the surface of a coating, corrosion in these areas will occur readily. Thus, the degree of porosity may serve as an indication of the protective value of the coating. Although there are a number of tests available for measuring porosity, it appears[1] that, due to their questioned reliability, these tests should only be used for qualitative comparison.

The more widely used test is the *Ferroxyl* method. Initially, the solution employed was sodium chloride-potassium ferricyanide for nickel on steel; however, due to the corrosive action of this solution, it was necessary to modify this test by excluding potassium ferricyanide.[45] The modification employed was in the use of a 25% rag-bonded paper impregnated with a solution containing sodium chloride and a gel such as agar. A contact method is employed in which the paper is placed on the surface of the test specimen and wetted periodically with sodium chloride solution. Indications transferred to the paper are later developed by immersion in a potassium ferricyanide solution; a blue coloration will indicate both the distribution and magnitude of the pores. This paper can serve as a permanent record. This test has also found acceptance in testing both silver[47] and tin[14] coatings.

While the Ferroxyl test is not applicable to coatings anodic to steel, as exemplified by both zinc and cadmium, it may be used when an externally applied emf is applied, this serving to break down the protective couple action so characteristic of an anodic coating. This procedure is basically an *electrographic* method, which has been extended to test a variety of coatings by changing the test solution. This method has been used successfully for zinc coatings on steel,[48] using the standard Ferroxyl solution; for gold and other noble metals on nickel,[49] using an addition of an ammonical solution of dimethylglyxoxime; and for tin-coated brass, copper coatings on steel, and chromium coatings on nickel.[14]

Immersion in distilled hot water[50] also may be used to detect pores in tin or nickel coatings on steel. This test is adaptable for checking gross porosity on large areas where complete inspection is necessary. The test temperature is maintained at 180°F. with the time of testing varying from 3 to 6 hours. Inspection is based on the number of rust spots after the test panel has dried.

The *Corrodkote* test[51,52] requires the application of a corrosive paste to the surface of the specimen tested, followed by exposure to a humid atmosphere for a period of 24 hours at a temperature of about 100°F. Recently, Bigg[66] reported the use of this test in correlating outdoor exposure tests in the Detroit area. The formulation of the synthetic soil was: cupric nitrate—0.035 g.; ferric chloride—0.165 g.; ammonium chloride—1.0 g.; 50 ml. water; and, 30 g. kaolin. It was concluded that this 24 hour test realized similar corrosive conditions as that realized by a one year outdoor exposure test in a Detroit atmosphere. Bigg suggested that it was an acceptable test for decorative chromium.

The *sulfur dioxide* test, which was developed in England[53] and adopted in that country[67] as an acceptance test, has been used to a considerable extent for duplex nickel/chromium deposit, with or without a copper flash on steel. Essentially, this test consists of exposure to a controlled humid atmosphere to which a small amount of sulfur dioxide gas is added; the concentration of the gas being from 0.5 to 2.0% by volume. The test has also been used on plated brass; however, some difficulty is experienced in determining the extent of corrosion. It has also been used[67] on plated zinc-base die castings with results similar to that experienced in outdoor exposure tests, with the exception that it is difficult to simulate the mode of failure that usually occurs with this type material, i.e., failure by blistering. Edwards[67] has indicated a wide acceptance of this test in England either as an acceptance or a production control test. The information obtained in a 24 hour test is used as the basis of acceptance; if basis metal corrosion occurs within this time period, coatings are judged inadequate for outdoor service. It is necessary to regulate the test temperature between 62 and 72°F. since a more stable humid atmosphere can be realized.

The *sodium chloride-hydrogen peroxide* test, which has been fully described by Shome and Evans,[54] is also used to some extent as a porosity test for nickel, chromium, and tin coatings on steel. The test is performed by immersion in a solution containing 3% sodium chloride and 1.5% hydrogen peroxide, the time period varying from 30 minutes to about 4 hours.[14] Large pinholes will appear in the form of rust spots in about 30 minutes, whereas, smaller pores in nickel and cobalt deposits will appear after a 2 hour immersion.[68]

The *salt spray* test has been accepted as a standard procedure in determining porosity, and as an accelerated test to simulate service conditions. Ever since the introduction of this procedure by Capp,[55] this test has frequently been subjected to criticism[56] for being unrealistic and misused.[57,58,59] Its role as a forecaster of service performance has been challenged, and failure to correlate test results with performance in actual atmospheric environments have been reported in literature.[60,61,62] Its continued demand as a performance test by both industry and governmental agencies is based, perhaps, on the philosophy that there is a lack of a suitable alternative.

Although the details of this procedure can be obtained from the ASTM standards, the modifications of this test may be given. These would include: (a) the standard 20% sodium chloride solution; (b) the 5% salt spray test using a 5% sodium chloride solution; (c) the acetic acid test. The essential difference[29] between the latter two tests is that the pH of the 5% salt spray test is maintained between 6.5 and 7.2, whereas, the acetic acid modification has a pH between 3.2 and 3.5. A fourth modification has been mentioned[29,78] in which a small amount of copper chloride is added to the solution. This modification, the CASS test, is not yet generally accepted.

A recent evaluation of the salt spray test, for the purpose of establishing both reliability and reproducibility, has been conducted by Mendizza[56] and reported in detail by Subcommittee III on conformance tests.[63] The salt spray tests were performed by four separate laboratories on panels that were prepared by six independent sources. The results clearly indicate a lack of agreement and, according to Mendizza, the test does not satisfy the minimum conditions of a standard accelerated corrosion test. Among the more important conditions cited were:

(a) Uniformity of conditions should exist in all test cabinets.
(b) Standard samples should be provided for calibrating the test cabinets.
(c) Standards should be included in all test runs.
(d) A continual check should be maintained on the behavior of the cabinet to see that it does not go out of control.

The *humidity* test is another method used in the determination of porosity of coating, its earliest application being the exposure of sheet tin plate[1] to steam. Since this method of testing is quite slow and not a very reproducible method for detecting porosity, it has been replaced by the hot water immersion test previously described.

Comparison Studies

Of interest is the work of Read and Lorenz,[64] who conducted an investigation comparing applicable thickness test procedures on Watts nickel coated steel panels. The test procedures selected for comparison included the magnetic method, BNF jet test, metallographic examination, stripping and cathode gain in weight (calculated). The only other study of this type was performed by Eddington;[65] however, it was noted[64] that there was difficulty in interpreting the results of this earlier work.

Although the details of the tests will not be given, it should be mentioned that extreme care was taken to assure uniformity in both panel preparation, plating and testing of the coating. The thickness of the coating tested varied from 0.0001 to 0.005″, which is in the range normally encountered in decorative and protective plating practice.

It was concluded that there is little to choose be-

tween the magnetic methods, the BNF jet test, and the metallographic method if certain limitations are recognized. Calibration of the magnetic instruments is essential. The BNF jet test is not satisfactory for thicknesses of 2 mils or more. The metallographic test, using a magnification of 500, is unreliable for deposits of 0.5 mil or less. Both the magnetic and the BNF jet tests are sensitive to structure and should be calibrated against standards which have been prepared in the solution and under the conditions which are used in plating the work. The stripping test was considered the most accurate.

A similar study was made on steel coated with copper. This study included all of the test procedures mentioned above plus a flux gauge. Acid copper deposit was selected, with the coating thickness ranging from 0.0001 to 0.005". Again, the stripping test procedure as recommended by the National Bureau of Standards (67 oz./gal. chromic acid + 6.7 oz./gal. sulfuric acid at room temperature) was found to be the most satisfactory. All the test methods are acceptable in most instances, with the following exceptions: (a) both the BNF jet test and metallographic examination, at x500, are not acceptable for deposits less than 0.0005"; (b) the flux type thickness gauge when the deposit is below 0.002"; and, (c) the BNF jet test for deposits that are 0.0025" thick or greater. The results obtained are given in Table 3.

Physical Testing of Coatings

The bend test, normally employed for zinc coated sheets, is a common method of determining both ductility and adhesion of coating to the basis metal. The standard for acceptance for zinc coated sheets is the absence of flaking; however, there may be some dispute as to what constitutes flaking. A similar method of test has also been adapted for zinc coated wire. There are a number of qualitative tests to determine *adhesion* of coating, including the chisel or knife test where one forces the tool between the coating and basis metal; the peening and burnishing test, in which the surface is either hammered or rubbed until blistering occurs; the twisting or bending test previously mentioned; grinding; and, by alternate heating and cooling of the test sample. None of these tests will give an absolute value, but will give a reliable indication as to the adhesion of the deposit.

The *Ollard* test, which has been thoroughly described in the literature,[69,70,71] is claimed[29] to be a reliable quantitative test in determining adhesion. The procedure consists of utilizing a rod that is plated in the normal cycle and machined to produce a test section. It is evaluated by means of a tensile test. The *sheet-adhesion* test can be considered a modification of the Ollard test[72] in that a flat specimen rather than a rod is the test section. The *nodule* test is another modification of the Ollard test,[73] whereas, the *adhesive-cement* test also uses the tensile test for quantitative evaluation. In the latter test, a rod or sheet specimen, which has been processed in the standard procedure used in production plating, is cemented to an extension that serves as the gripping area in a tensile test. Careful selection of the bonding agent is required, since the strength of the adhesive is the limiting factor. Usually, the maximum test value is about 6,000 psi.

TABLE 3a

Thickness of Nickel Plate on Steel as Determined by Five Methods[64]

(All Measurements × 0.00001")

Panel Number	Calculated Value	Magnetic Method	BNF Jet Test	Metallographic	Stripping Test
5a	10.8	12.8	10.9	13.2	11.1
5b	11.4	13.3	12.5	13.2	11.9
6a	26.5	32.0	27.6	28.4	27.2
6b	28.0	32.9	28.8	30.8	29.0
1a	52.7	63.6	52.9	60.2	54.1
1b	52.5	63.1	53.6	56.5	54.0
7a	81.5	87.7	78.5	85.2	84.6
7b	79.2	85.7	82.3	83.8	83.1
2a	103.3	112.7	103.6	110.3	105.7
2b	108.3	119.1	106.2	113.5	109.0
3a	202.0	194.0	217.0	211	204
3b	—		280.0	244	244
4a	318.0		340.0	333	327
4b	315.0		342.0	323	318
8a	516.0		513.0	536	520
8c	520.0		617.0	539	523

TABLE 3b

Average Thickness of Acid Copper on Steel as Determined by Seven Methods

(All Measurements × 0.00001")

Panel Number	Calculated Value	Stripping Test	Metallographic	Magnetic Methods A	Magnetic Methods B	Flux Gauge A	BNF Jet Test
a5a	14	14	12	15	—	19	11
a6b	14	13	11	15	—	18	10
a7a	58	59	53	60	54	59	51
a7b	61	62	57	64	60	64	55
a9a	110	112	105	124	107	116	96
a9b	111	111	104	122	105	115	101
a11b	282	279	278	294	266	295	290
a12b	307	308	292	318	281	315	234
a12a	569	555	557	578	500	551	509
a21b	578	584	579	586	515	571	477

Of interest is the *bulge* test, as detailed by Read and Whalen[74] and by Prater and Read,[75] which measures ductility of a plated metallic coating. The test is evaluated by the height of a bulge, expressed in strain values and read directly from working graphs. There are a number of difficulties, among which is the lack of a unit, such as per cent or length; in obtaining a metallic coat by stripping off the basis metal, the stripping solution may affect the coating evaluated; and, by divorcing the coating from the basis metal, the mutual effect of the composite is lost.

Essentially, the test specimen is plated on a very thin basis metal strip; the separation of this composite section — basis metal from coating — may be done by producing conditions for poor adhesion of coating so that the deposit may easily be peeled, or by using a solvent which will preferentially dissolve the basis material and leave the coating intact. Since three principal stresses are involved, difficulty in interpretation may be experienced; however, it had been stated[74] that experience with the test will aid in evaluation.

It had also been stated[74] that the ductility values

obtained by the use of specially designed equipment, which has been described in detail, will be influenced by the basis metal employed, the coating thickness and, in the event of testing a composite section, the thickness of the basis material. The strain rate, as well as the distribution of pinholes and length of aging, have little or no effect on the values obtained.

The *hardness test* is also used to some extent; however, this procedure is used more frequently for industrial applications than those in the decorative field. The test, basically, is a "penetration type" in which an indenter penetrates the coating upon the application of a load, the value of this load being directly related to the depth of penetration. Thus, on thin coatings, a Knoop hardness tester is recommended, since a load as small as 1 gram can be applied, and the indentation is so small that a magnification of 500 on an attached microscope must be used for evaluating hardness. Other test equipment, which have loads of greater magnitude, are the Vickers, the Superficial Rockwell, the Standard Rockwell, and the Brinell. These machines may be used for coatings of increasing thickness. It is essential that the proper choice of test be made since it is desirable that the coating is not penetrated. Otherwise the hardness of the basis metal rather than the coating is obtained.

Visual Inspection

Regardless of the excellency of properties that an electrodeposited coating may possess, the appearance of the finished product is of extreme importance, particularly to the consumer who usually is not technically-minded. This places an additional burden on the fabricator to provide (a) a luster and color that will be pleasing, and, (b) a decision as to the surfaces deemed critical, usually those surfaces that are exposed to the critical eye of the consumer.

The standards used to judge both luster and color of an electroplated item may vary in accordance with individual opinion, and frequently it is necessary to place these standards on an individual basis. Thus, the inspection department of both the producer and a purchaser, particularly where large quantity parts are involved, should come to an agreement as to standards. Egeberg and Promisel[76] expressed the brightness of a plane surface as the ratio of specular reflection (in which the angle of reflection is equal to the angle of incidence, 45° in their tests) to the diffuse reflection (i.e., the reflection of all other angles). This method is only applicable to plane surfaces[77] but may be useful on deposits from "bright plating solutions."

Morse[1] has listed a number of factors that appear to be important in determining a satisfactory bright finish, namely, (a) maximum reflection of incident light; (b) clear image reflectance; (c) absence of diffused reflectivity; and, (d) color of reflected light. The use of standard panels is usually unsatisfactory, since the curvature of the surface frequently has a more important effect than the degree of brightness. A curved surface will usually look better than a flat panel of equal brightness. In many cases, samples of the actual part, which would cover the range normally obtained in production, are taken and evaluated as to acceptability in a sequence of the highest and lowest values. These standards, based on mutual agreement, can then be used as "masters" to which subsequent plated parts can be compared.

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(*Continued on page* 51)

Finishing and Marking of Meter Dials

By James Lind, *Finishing Engineer, Weston Electrical Instrument Corp., Newark, N. J.*

The author is a graduate of the University of Massachusetts with a B. S. degree in chemistry in 1942, and has also attended graduate school of Brooklyn Polytechnic Institute and Newark College of Engineering.

A member of the A. E. S. Newark branch, he is presently on the local branch Educational Committee.

Jim is in charge of the Metal Finishing Laboratory of Weston Instrument where he is active in research and development along with doing trouble-shooting work on organic and inorganic finishes. He was previously associated with Wright Aeronautics Division, Curtiss-Wright Corporation.

THE manufacture of a high quality calibrated metal dial is an intricate operation. A dial (otherwise referred to as a scale plate), with its associated pointer or pointers, is that part of an instrument which indicates the value of the item being measured, such as volts, amperes, degrees, feet, miles, pounds, etc. At Daystrom, Inc., Weston Instruments Division, dials are finished with various types of coatings and then are printed, each for a specific purpose.

The steps involved in the production of dials consist of the punching out from the raw material, the pretreating and painting operations, and the printing of the required scale divisions and captions.

The raw material, which may be aluminum, brass, steel or nickel-chromium preplated brass, are purchased in both coil and flat stock. The coil stock is mounted on an electric coil cradle and fed automatically through a straightening machine. The flat sheet stock then is hand-fed directly through a punch press.

Since over one thousand different types of dials are manufactured, an equal number of dies always are available for immediate positioning in the punch presses.

Cleaning and Application of Base Paint

After the dials have been punched out, they are shipped to stock without cleaning. Since a corrosion-resistant lubricating oil is applied to the dials during the punching operation, rust or tarnish of the parts does not occur during storage. When a specific type of dial is required in an assembly area, the prepunched blanks are withdrawn from stock and shipped to the finishing department for processing.

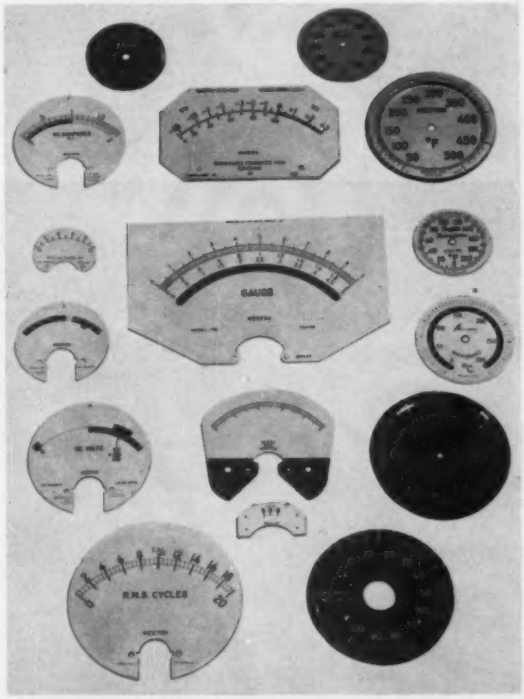
Prior to the application of the final coat of a paint, the aluminum, brass, and steel dials are pretreated in different ways.

Aluminum Dials — After vapor degreasing and hot alkaline cleaning, a corrosion-resistant chromate conversion coating is applied.

Brass Dials — The dials are cleaned properly, bright dipped in a sulfuric-nitric acid solution, and a hard, semi-bright nickel coating is electrodeposited.

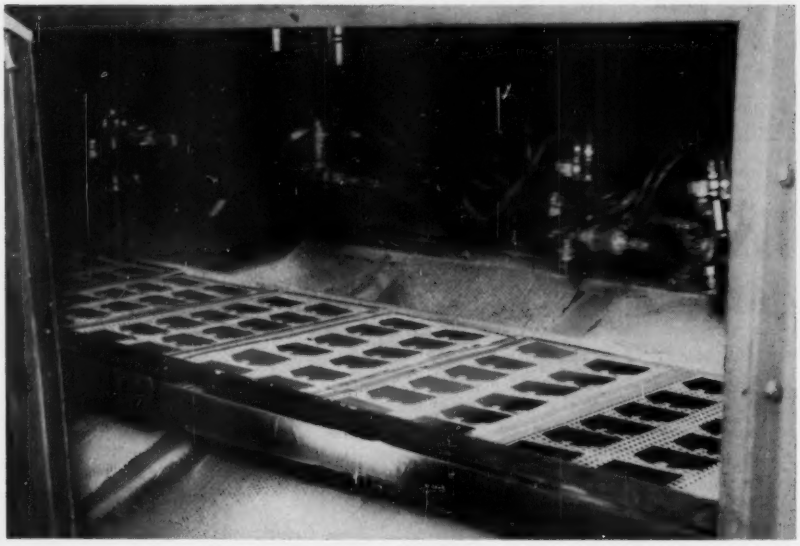
Steel Dials — After vapor degreasing, a very thin spray coat of a zinc chromate wash primer is applied to both sides of the dials.

The prefinished dials then are placed on trays and

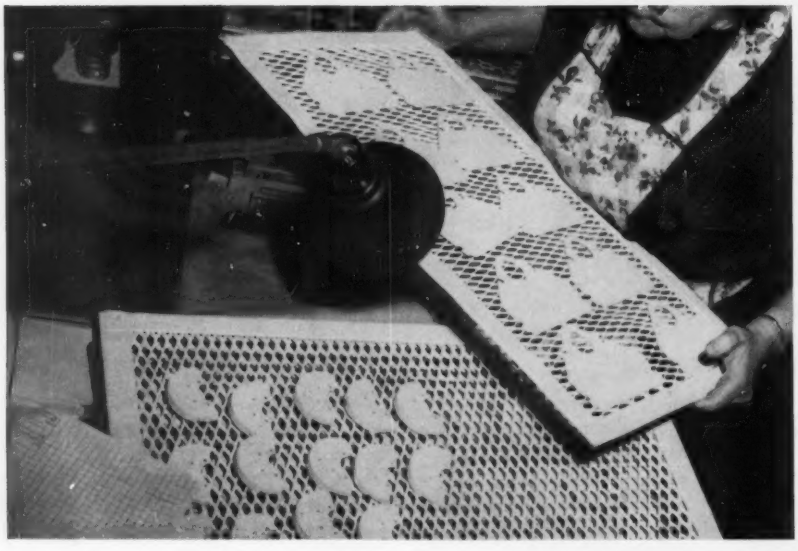


Display of dials typical of those made at Weston Instruments Div.

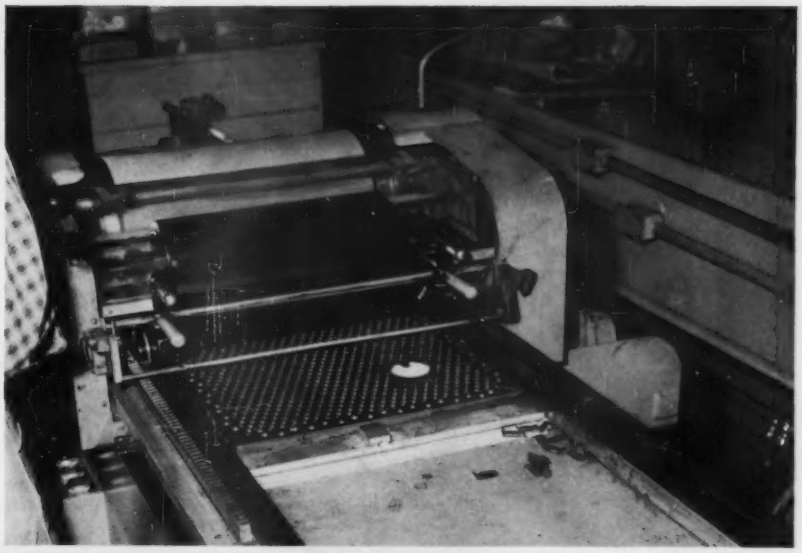
Steel dial plates on rack prior to application of finish.



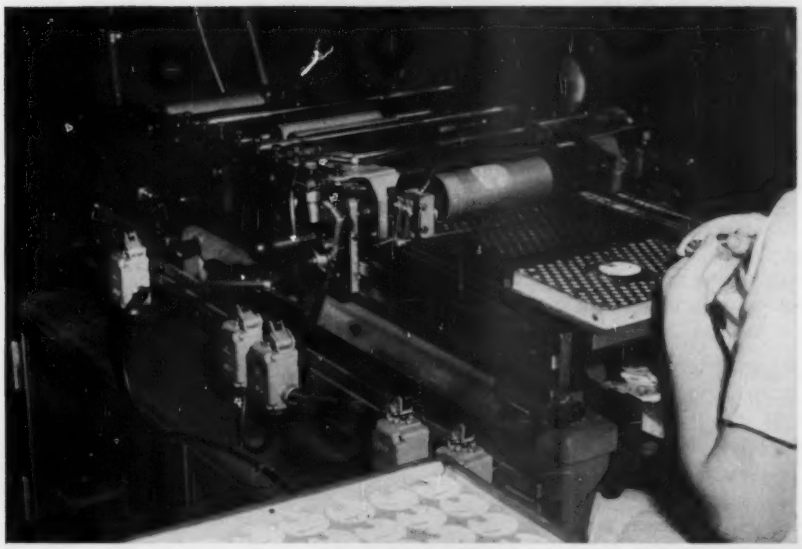
Automatic spraying of dial plates.



Inspection of enameled dial plates prior to application of markings.

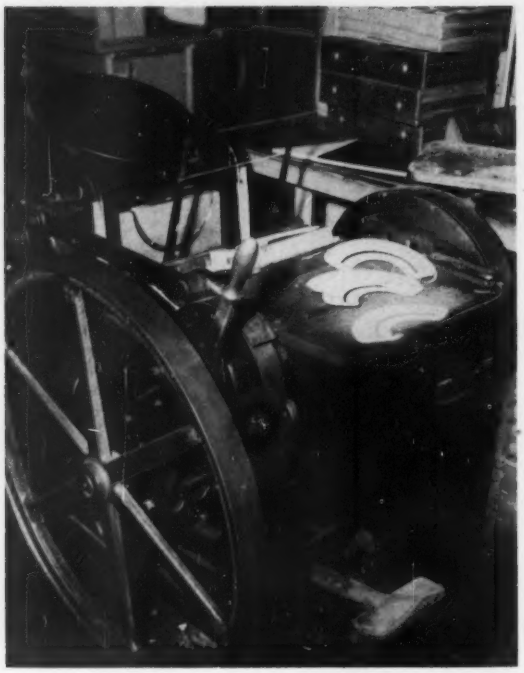


Vandercook dry offset printer used for quantities over 100.



Transfer floor press used for parts over 3½" diameter and which are produced in relatively small quantities.

Bench type offset printer used for small quantities of dials and readily adaptable to multicolor printing.



Movable type method for printing dials.

painted either manually or by means of an automatic paint spraying machine. When a large quantity of dials, even of assorted sizes and shapes, requires one particular finish, it is sprayed on the automatic paint spraying machine. When a smaller quantity of one finish is required, it is hand sprayed.

Various types of paints are applied to dials, but the most widely used finish is manufactured especially for Weston and is known as Fume-Proof White Baking Enamel. As the name infers, this paint does not discolor when exposed to the fumes of cured or uncured Bakelite, rubber, ammonium hydroxide, ammonium polysulfide, and phenol at 85°C. for 350 hours. This is of major importance since the dials must not discolor during service.

Each shipment of new enamel is checked carefully for non-yellowing to fumes, pounds per gallon, color, and adhesion to various basis metals to insure uniform quality paint for production. Furthermore, each ingredient of the paint is evaluated periodically by the paint manufacturer to make absolutely certain that no changes have been made by the raw materials producers.

Flat Black Instrument Baking Enamel, which meets Government Specification MIL-E-5557, Type IV, is another paint which is widely used at Weston. This finish usually is applied by manual spray, rather than by the automatic paint spraying machine, because smaller quantities of dials per order are needed. In some special instances, this finish is applied over the white baking enamel for hand calibration of very high accuracy dials.

Other finishes, used mainly on thermometer dials, are an aluminum heat-resistant baking synthetic enamel, and a gloss black baking enamel. The latter enamel replaces a black anodized aluminum finish.

The paints used must exhibit exceptional adhesion when checked by the tape test, conical mandrel, scratch test, and thermal shock tests. There should be no degradation of the paint film after 250 hours of 20% salt spray cabinet testing and after 30 days of humidity cabinet testing.

After the dials have been painted and properly baked, they are submitted to the inspection department for 100% inspection. They are rejected for the slightest defects, such as dirt, scratches, lack of coverage, off-color, gloss, etc. The acceptable dials then are packaged automatically in plastic bags for protection in further handling and shipment to the printing departments.

Printing on Base Paint

After the paint has been applied to the dials and inspected, the dials are printed by one of several methods available, including dry offset printing, silk screen printing, rubber-type printing, and hand calibrating.

A. *Dry Offset Printing*:

This process consists of a magnesium plate, coated with ink and transposed to a rubber mat which, in turn, transfers it to the dial.

B. *Letter Press Method (zinc cut or movable type)*:

This is the old method of printing dials and is used mainly on paper for mirror scales. The paper is par-

Silk screen method of printing used both for marking with inks as well as with paints.

tially printed and then mounted on the nickel-chromium preplated brass mirror dials.

Many such jobs have of recent been changed to Vandercook machines, whereby the unprinted paper is mounted on the mirror scale and then printed. Other jobs gradually are being changed to fume-proof white enamel as well as silk screen white, thereby eliminating the paper.

C. *Silk Screen Printing*:

Fluorescent, phosphorescent, and luminescent paints, as well as regular screening paints, are applied by this method. This is a hand operation at Weston since only small quantities of one color are usually required. This process usually is performed on a black scale with a white undercoat under the final screened color. The white is necessary in order to bring out the brightness of the fluorescent, phosphorescent, and luminescent finishes.

D. *Reverse Printing*:

This method is used only on hand calibrated dials with a black background. The process starts with the fume-proof white enamel, upon which the necessary lines or figures are hand calibrated with a water-soluble protective ink. This is air dried, and black printers' ink then is rolled over the entire surface. After another air drying, the dials are immersed in water, dissolving the protective ink and leaving a black scale with white lettering. Silk screening is then used if any additional white printing is required.

E. *Hand Scribing*:

Additional individual marks on the dials must be hand scribed when the dials, for special reasons, are not printed completely. Such additions to the scales are serial number, full scale range, model number, sales order number, and any other such code numbers.

Operator shown at bench position for hand scribing specialty dials.

Final inspection of dials prior to assembly.

After the dials have been printed completely, they are once again given a 100% inspection before being mounted in an instrument, and are rejected by specially trained inspectors who look for, in many cases, even the slightest imperfections. The finished dials are then mounted into the proper instruments.

Conclusion

Dials must be able to withstand environmental conditions to which they may become exposed. Some of these conditions are high humidity, salt water, outer space environments, acid and alkaline fumes, and solvents. For easy reading, the dials must show good contrast between background and lettering or figures, and must be attractive for consumer appeal at all times.

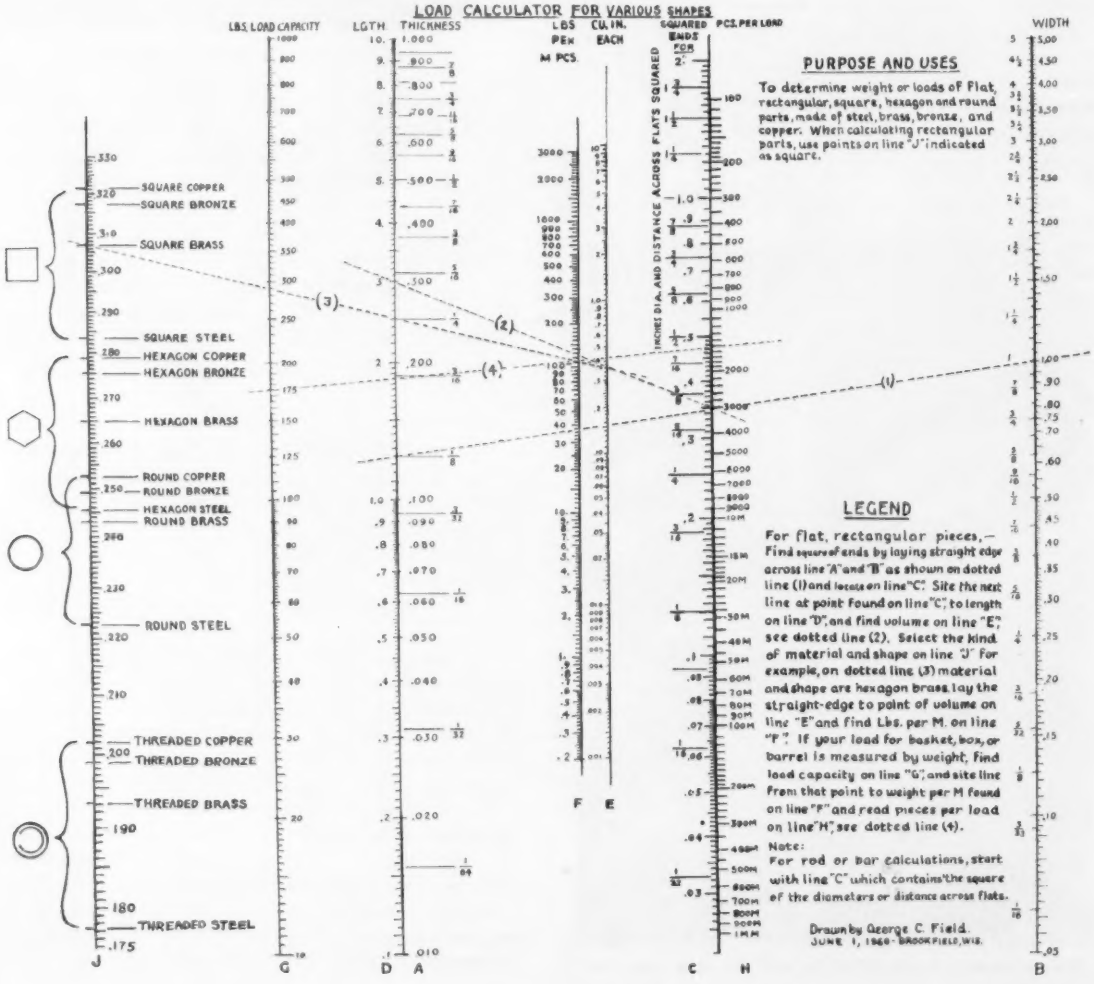
For the successful manufacture of accurate dials, there are several factors to keep in mind. The personnel must be competently trained for each phase in the development of this product. Particular work, such as silk screening, hand calibrating, and machine printing, require exceptional skills for the maintenance of high quality products. The careful selection of spraying paints, printing inks, and screening enamels plays an important role in the continuance of unexcelled dials or scale plates. Careful inspection of the dials from step to step insures that only top quality dials or scale plates will finally become part of the finished instruments.

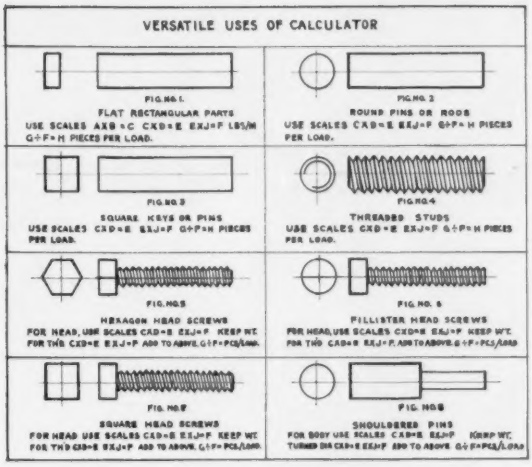
A Load Calculator for Various Shapes

By Geo. Clayton Field, *Brookfield, Wis.*

THE chart shown here may appear to be complicated, but its only real complication is the number of scales required to make it as universal as it is. To be universal, it has many applications but it is not always necessary to use all of the scales. The key to its successful operation is to choose the proper scales and method for the shape of the part being calculated. If one studies the thumbnail sketches, entitled VERSATILE USES OF THE CALCULATOR, it will be noticed that Fig. 1, the flat rectangular part, is the only shape that requires the use of the scales "A" and "B," thickness and width. For Figures 2-8, they are not used, but the second step at scale "C" becomes the starting point. Because the square inches do not really have to be read, they are omitted, and only the diameters or distances across flats are shown. These, of course, are squared in the construction of the chart.

Once having learned the purposes and use of the scales, this calculator can be used to replace other





charts which were designed for many specific purposes, shapes and materials. The only way to learn to use the calculator efficiently, is by practice. The first method to be described, is that of flat rectangular parts (Fig. 1).

Example: It may be necessary to calculate the load for a flat part 1/8″ thick by 1″ wide by 3″ long, made of brass. The first step is to locate 1/8″ on line "A" and 1″ on line "B"; lay straight-edge across, as indicated by dotted line (1) and find the point of intersection at line "C", as 0.0354″ square which would be equal in value to 0.125 square inches. Next find the length of 3″ on line "D" and read the cubic inches on line "E" as 0.375, shown by dotted line (2). Then hold point of 0.375 cubic inches on line "E", swing straight-edge to the point on line "J" marked "Square Brass," and read the value of 115 lbs., as indicated by dotted line (3). Hold the point of 115 lbs. and select load of 175 lbs. on load capacity line "G", swing straight edge to that point and read the number of pieces as 1525 on line "H", as indicated by dotted line (4).

The above example is the longest process of this calculator, as may be seen on the table of sketches and figures. For instance, if we were to calculate the load for a steel rod or bar selected as Fig. 2 shape, we would start with scale "C". Find the diameter there and lay straight-edge from that point to the point of length on line "D" and find cubic inches on line "E"; then swing straight-edge to the point on line "J" marked "Round Steel," and read the lbs. per M pieces on line "F". To find the number of pieces per load, select the load capacity of barrel or basket on line "G", turn straight-edge to that point and read the pieces per load on line "H".

For a square copper key or pin such as seen in Fig. 3, proceed as in Fig 2 except select "Square Copper" on line "J" instead of "Round Steel." For the figures 5, 6, 7, and 8 where there are two diameters or distance across flats, to calculate a square-headed screw, merely proceed to obtain the weight in lbs. per M pieces for each step, such as the square head first and the threaded diameter second, add together and, using the total, find the number of lbs. per M pieces on line "F", locate load on line "G", and read the number of pieces per load on line "H". It is necessary, of course, to keep in mind the shape and kind of material of the part being calculated. The sketches of various shapes, with respective figure numbers, designate the proper scales to use. It is only necessary to select the proper points on each of the scales and read succeeding results by using the straight-edge. With some care and a little practice, it is possible to use this calculator and save considerable time, and still obtain an approximation of the size of loads required in the plating room.

EVALUATION OF ELECTRODEPOSITED COATINGS

(*Continued from page* 44)

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Hardness of Electroless Nickel Deposits

EFFECT OF HEAT TREATMENT

By Larissa Domnikov, *Process Analyst A, Norair Division, Northrop Corp.*

AN interesting report describing the effect of heat treatment on the hardness of electroless nickel coatings was recently published in a Russian metallurgical journal (Metal Science & Heat Treatment).

The literature on electroless nickel deposits contains contradictory data on the effect of various heat treatment conditions on the hardness of nickel-phosphorus alloy deposits. According to some references,[1] the microhardness of the deposits, after heating to 350-400°C. and holding at that temperature for 1 hour, is 700-800 kg/mm². According to other references[2] it is 1000-1100 kg/mm². Some authors[3] obtained a microhardness of 530-570 kg/mm² after heat treating for 40 minutes at 400°C., others obtained about 1000 kg/mm² after heating at the same temperature for only 10 minutes, with subsequent prolonged heating having no effect on the coating hardness.

The Russian researchers conducted a series of experiments and established the optimum conditions for heat treating electroless nickel deposits. Fuel pump plungers 8.5 mm in diameter, of steel containing 0.97% C, 0.16% Si, 1.09% Mn, 0.92% Cr, and 1.18% W were used as test specimens. On the surface of these parts, coatings 15-16 microns in thickness were deposited from an electroless nickel bath. The plating process was conducted at 90-94°C. from a solution containing 30 g./l. nickel chloride, 10 g./l. sodium hypophosphite, and 10 g./l. sodium acetate. The microhardness of these deposits was 420-466 kg/mm² before the heat treatment. The effect of heat treatment on the deposits was studied at 150, 200, 250, 300, 350, 400, 500, 600, 700, 750, and 800°C., with different heating periods.

As a result of the heat treatment, conducted in an electric oven at temperatures above 300°C. with subsequent air-cooling, a thin oxide film was formed. The thickness, density, and color of the film varied, depending on the temperature and the heating time. The tests indicated that, at 400°C., the film was denser than at 600°C. At higher temperatures the density of the oxide film decreased, and, at 750°C., the film was softest and most friable.

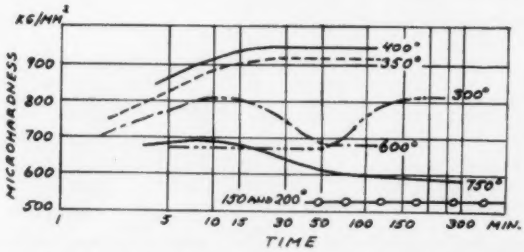
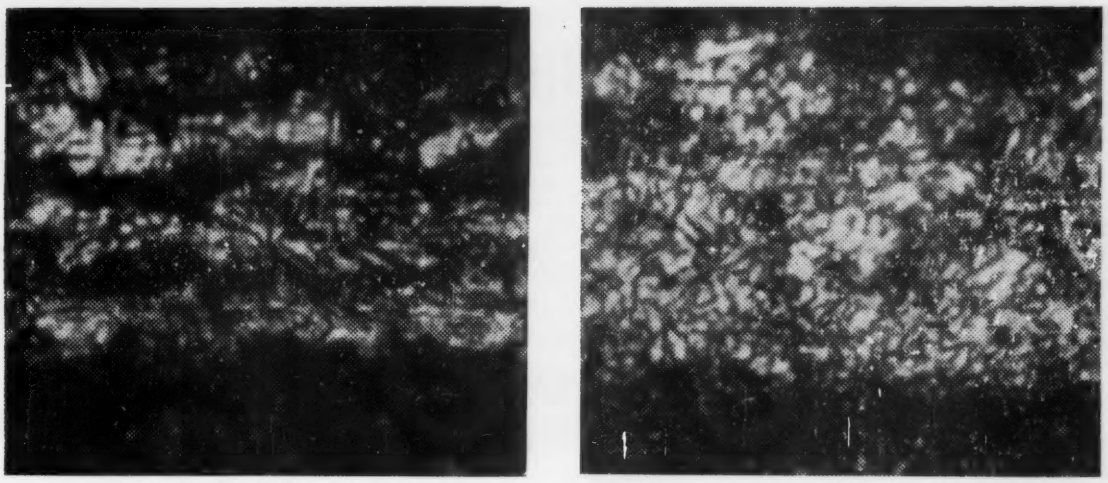


Fig. 1. Effect of heat treatment on microhardness of nickel-phosphorus deposit.

Fig. 1 shows the effect of heat treatment conditions on the coating microhardness. The change in the microhardness of nickel-phosphorus deposits is related to the change in the structure of the alloy. An extremely high dispersion makes it difficult to determine under the microscope structural changes resulting from different heat treating conditions, especially after heat treating at low temperatures. The laminated structure of the deposits before the heat treatment disappears after heating (Fig. 2).

The Russian researchers conducted an X-ray analysis of the chemical nickel deposits in order to study the effect of heat treatment conditions on the character of phase transformations of the nickel-phosphorus coatings. The X-ray pictures of the deposits before heat treatment differ considerably from the X-ray pictures of the deposits after heat treatment (Fig. 3), which fact points to the appearance of a new phase. From the visual examination of the X-ray pictures of the coatings it can be concluded that changes in the heat treating temperature, within the range of 400-700°C., produce no phase transformations in the nickel-phosphorus deposits, i.e. the established phase is fairly stable.

The lines in the X-ray picture of the deposits which



(a) (b)

Fig. 2. Microstructure of nickel-phosphorus deposit. X 600. (a) before heat treatment; (b) after heat treatment at 400°C. for 60 min.

have received no heat treatment correspond to the finely dispersed nickel. All X-ray pictures of the coatings which have received heat treatment under different test conditions showed lines of nickel and of a nickel phosphide, formed as a result of heating. This phosphide does not correspond to the well known compounds of the Ni_2P and Ni_7P_3 type.

Thus, the X-ray analysis indicated that the changes in the hardness of the nickel-phosphorus deposits as a result of the heat treatment are related to the formation of a phosphide whose composition remains as yet unknown. A slight increase in the microhardness of the nickel-phosphorus coatings as a result of heating at 150-200°C. can be explained by the fact that, apparently at this temperature, an incomplete formation of the above-mentioned phosphide takes place. The change in characteristics of the deposits under different heat treating conditions at higher temperatures can be explained by the coagulation of the phosphide.

The above statement is supported by the changes in the microstructure of the nickel-phosphorus coatings (Fig. 4). After heat treating at 750°C. for 5 minutes, a relatively finely-dispersed structure of the alloy is observed. As a result of heating for 30 minutes at the same temperature, a marked coagulation of the phos-

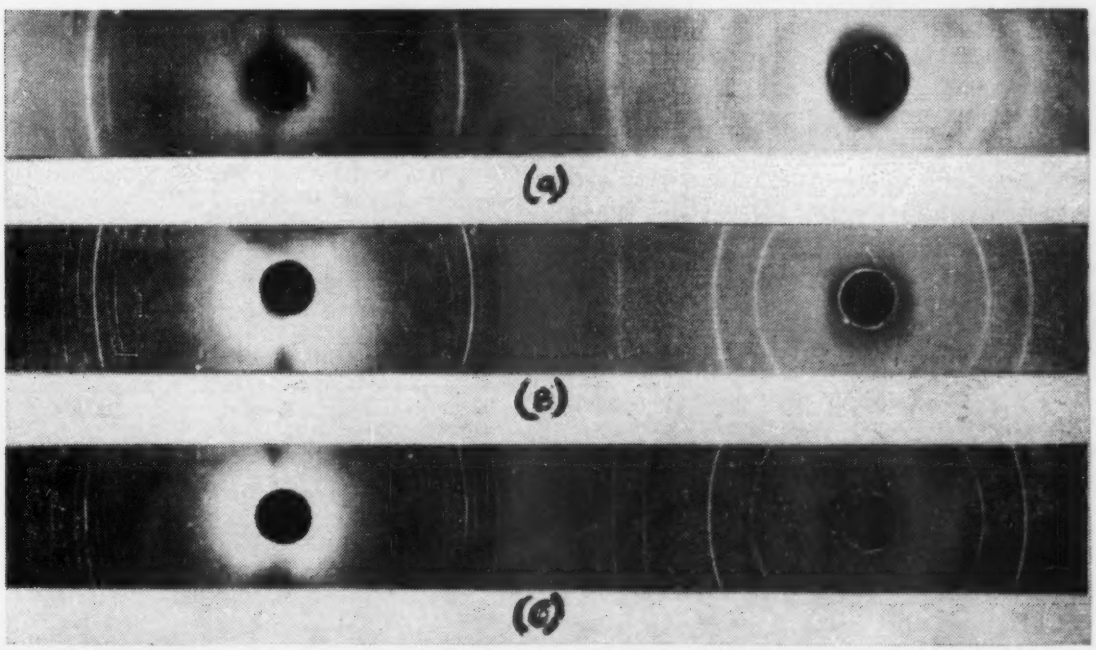


Fig. 3. X-ray pictures of a nickel-phosphorus deposit: (a) before heat treatment; (b) after heat treatment at 400°C for 15 minutes; (c) after heat treatment at 750° for 15 minutes.

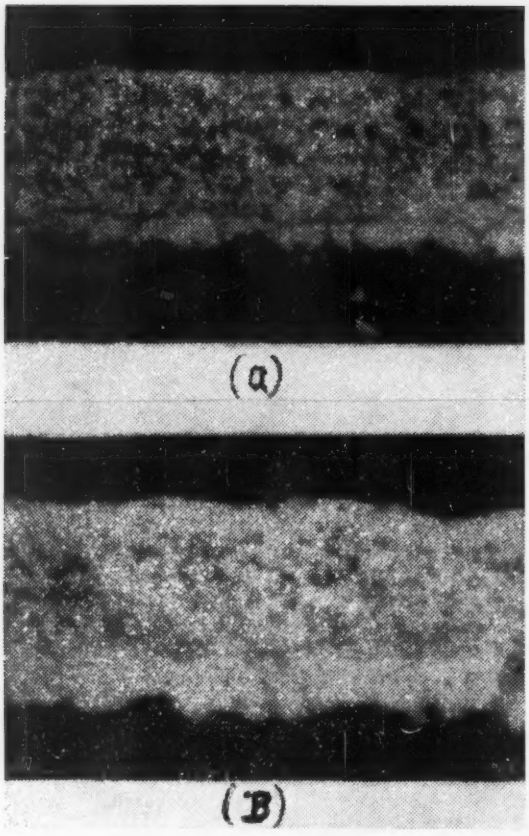


Fig. 4. Microstructure of nickel-phosphorus deposit after heat treatment at 750°C. X600. (a) 5 minutes; (b) 30 minutes.

phide takes place (dark areas in the structure). It should be noted that the coagulation of the phosphide results in its nonuniform distribution through the cross-section of the coating. With longer heating periods, the width of light bands at the edges of the coatings increases, this fact pointing, apparently, to the diffusion of the phosphide in a direction toward the center. These processes result in the impoverishment of the coating surface in nickel phosphide, and in the decreased microhardness of the surface layer.

In the temperature range of 350-400°C., the microhardness of the coatings increases independently of the heating time (Fig. 5). The formation of the nickel phosphide at these temperatures results in increased hardness during the initial period of the heat treatment. Subsequent heating does not produce any decrease in hardness because these temperatures are not high enough for coagulation of the phosphides, and the structure remains undiscernible under the microscope. At higher temperatures the coagulation starts taking place, the rate of coagulation being proportional to the temperature and the heating time.

If the coatings are subjected to heat treatment at 500°C. and above, when the coagulation takes place

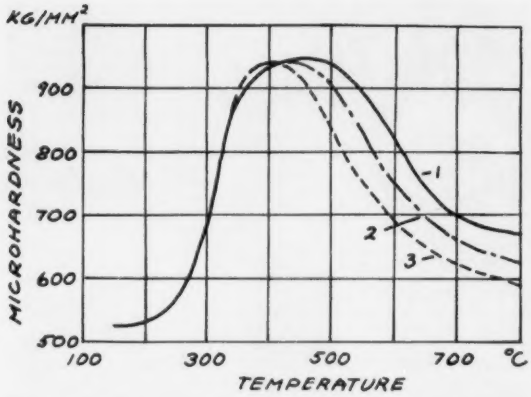


Fig. 5. Effect of temperature and heating time on microhardness of nickel-phosphorus deposit: 1. 15 minutes; 2. 30 minutes; 3. 60 minutes.

fairly rapidly, the amount of larger nickel phosphide particles grows markedly in time, this resulting in decreased hardness of the coatings. Thus, with increase in the heat treating temperature above 500°C., two processes take place in the nickel-phosphorus deposits, which affect the hardness of the coatings in two opposite directions: the formation of the phosphide, and its coagulation (Fig. 5). From examination of the curves, one can see that, with the increase in temperature from 500 to 800°C., the microhardness of the coatings decreases, the decrease being more intensive with longer heating periods.

Microhardness of the deposits of 750 kg/mm² and higher can be obtained by heating at 350-550°C. The highest hardness (950 kg/mm²) can be obtained by heating to 400-450°C. and holding at that temperature for 15 minutes.

Increasing the heating time at 400°C. does not result in any changes in the hardness and, at 500°C., even results in some decrease in hardness. However, considering that the longer heating periods improve the coating adhesion to the basis metal due to diffusion, it is reasonable to establish a heat treating time of about 40-45 minutes. Thus, the optimum heat treating condition of the nickel-phosphorus coatings from the standpoint of their hardness and adhesion is 400-450°C., holding at that temperature for 40-45 minutes.

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Anodizing Aluminum Alloys

EVALUATION OF THICK (HARD) COATINGS

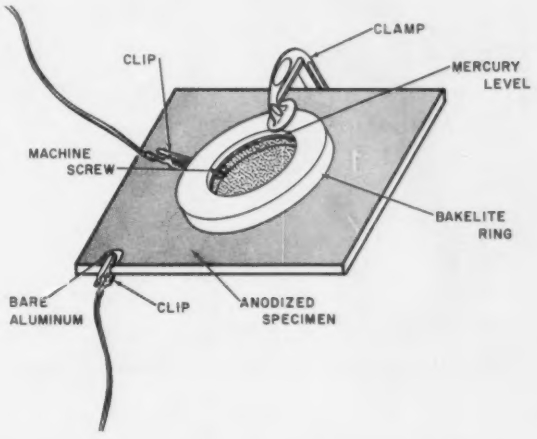
By Irving Machlin, *Materials Engineer, Bureau of Naval Weapons and*

Neal J. Whitney, *Assistant to the Director, Engineering & Research Div., John I. Thompson & Co., Washington, D. C.*

PROCESSES for anodizing relatively thick coatings (known commercially as "hard coats") on aluminum and its alloys have been developed in recent years. The techniques used are somewhat different from conventional sulfuric or chromic acid bath anodizing processes, and may involve high current densities and modification of electrolyte refrigeration and bath agitation practices. Coatings of 0.01 inch are attainable; however, thicknesses in the 0.0010-to-0.0025 inch range are most commonly specified.

These relatively thick coatings are reported to be abrasion- and corrosion-resistant, and to have high dielectric strength. Conventional sulfuric or chromic acid anodized coatings, used principally for corrosion resistance, dye retention, or limited abrasion resistance, are normally in the range of 0.0001-to-0.0008 inch thick.

Coatings 0.001-to-0.005 inch thick on 2024-T3 and 6061-T6 aluminum, produced by four different processors, were evaluated to obtain data for a military specification on "hard" anodizing. Investigation was made of coating characteristics, including Taber abrasion resistance, dielectric breakdown strength, Knoop indenter penetration, and salt spray corrosion resistance. The discussions which follow refer to coatings applied by any of the four processors, since results indicated similarity of properties under the test conditions. Thickness of coatings was measured non-destructively by use of a commercial instrument which utilizes the effect of eddy currents, induced by a crystal oscillator, as a basis for measuring coating thickness.



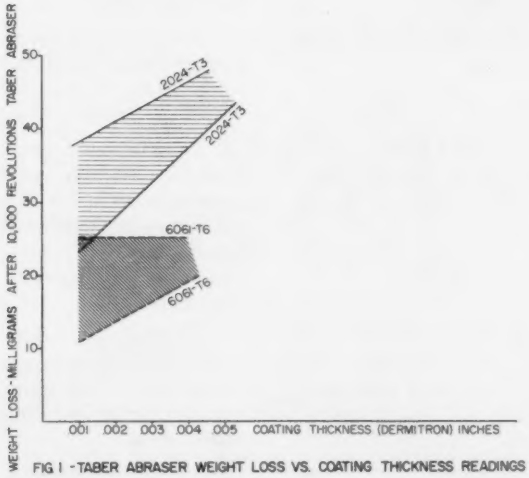


FIG. I - TABER ABRASER WEIGHT LOSS VS. COATING THICKNESS READINGS

Abrasion Test

Each sample was weighed to the nearest milligram and then abraded with a CS-17 Taber wheel (weighted with 500 grams) for 10,000 revolutions at 70 r.p.m. After every 1,000 revolutions the wheels were redressed using S-11 abrasive paper for 25 revolutions. Upon completion of the tests, the samples were again weighed to the nearest milligram and the weight loss was tabulated.

Figure I compares the weight losses of 2024-T3 and 6061-T6 anodized specimens for equivalent coating thicknesses. Weight losses increased with thicker coatings, particularly for 2024-T3 specimens. The coatings on about one third of the 2024-T3 specimens tested were worn through to the basis metal, resulting in discard of the specimen. None of the 6061-T6 coated specimens were worn through.

Dielectric Breakdown Voltage

Dielectric breakdown voltages were determined by the ASTM B-110 method and a "mercury pool method*." The ASTM B-110 method gives dielectric breakdown voltage over an area contacted by a movable probe having a spherical tip of $\frac{1}{8}$-inch radius. The mercury pool method gives breakdown voltage over a circular area $2\frac{1}{2}$-inches in diameter, as indicated in the sketch above.

*Test suggested in private communication from R. F. Hafer, Reynolds Metals Co.

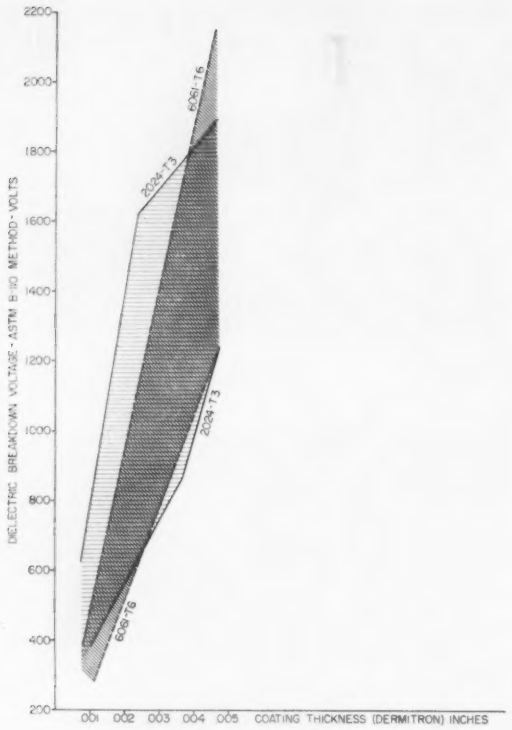


FIG. 2 - COATING THICKNESS VS. ASTM B-110 DIELECTRIC BREAKDOWN VOLTAGE

The mercury pool test method evaluates an area of about 5 square inches and is more likely to discover points of low dielectric strength than the ASTM method, which evaluates only randomly selected spots under the probe tip.

Figure 2 shows ASTM B-110 breakdown voltages as a function of thickness readings. Figure 3 compares ASTM B-110 and mercury pool test breakdown voltages for the same specimen. Breakdown voltages tend to higher values as coating thickness increases. It is noted that specimens with coatings less than 0.0025 inch thick frequently indicated a short circuit under the mercury pool test. This condition is attributable to mercury penetrating to the basis metal on specimens tested, but it is not known whether a high incidence of such penetration is to be expected in coatings produced especially for dielectric applications. The generally superior abrasion characteristics noted for coatings on 6061-T6 as compared to 2024-T3 were not necessarily indicative of superior dielectric properties.

Indentation Resistance

Coated and uncoated specimens were subjected to indentation by a Knoop indenter under a 500 gram load.* Specimens were prepared for testing by polishing with a fine emery cloth, removing 0.0001-to-0.0003 inch of surface. The length in microns of the long diagonal of the penetrated area was observed as a measure of indentation resistance. However, coatings were brittle, and a valid reading was defined as one wherein the lengths of the two segments of the long diagonal were equal within ten percent and where the two segments of the short diagonal were similarly proportional. The readings are considered to be a tool for control and inspection of coatings, rather than a measure of true coating hardness. Figure 4 shows Knoop indentation readings as a function of coating thickness for both alloys. Indentation values for 2024-T3 covered a wide range, indicating coating variability, and the length of indentation tended to increase with increase in thickness of coating. For 6061-T6 specimens, the spread in indentation values were smaller, and the length of indentation remained essentially constant with increase in thickness of coating. Comparison of Figures 1 and 4 indicates that there may be a relation between performance in the abrasion test and indentation resistance.

*Test suggested in private communication by Ellis P. Owens, Sanford Process Co., Inc.

Salt Spray Tests

Appearance of the test panels was judged after exposure to a 240 hour 20 percent salt spray test, in conformance with Federal Test Method Standard No. 151, Method 811. The results of visual examination are given in Table 1.

Resistance to salt spray was not influenced noticeably by coating thickness, continuity of the coating being a more important factor. Apparently, it is more difficult to provide a continuous coating on the 2024 alloy, judging from the superior salt spray results noted for the 6061 alloy.

Conclusions

Taber Abraser weight losses for 2024-T3 anodized specimens were generally higher than those for 6061-T6 specimens of equivalent coating thickness, indicating that coating properties are influenced by the basis metal. Although the correlation between weight losses and performance under particular service conditions

TABLE 1

Visual Examination after Salt Spray Test

Specimen	*Description*
Uncoated 2024-T3 (control)	Extensive white corrosion products. Pitted.
Uncoated 6061-T6 (control)	Large areas of white corrosion products. Pitted. Superior to the 2024-T3 uncoated specimens.
Anodized 2024-T3 specimens (0.008-to-0.005 inch thick coatings.)	18 of 20 specimens showed white corrosion products, ranging from a few pitted areas to numerous pitted areas. Two specimens were in excellent condition.
Anodized 6061-T6 specimens (0.0008-to-0.005 inch thick coatings.)	18 of 22 specimens exhibited little or no evidence of corrosion. Four specimens showed a few white pitted areas.

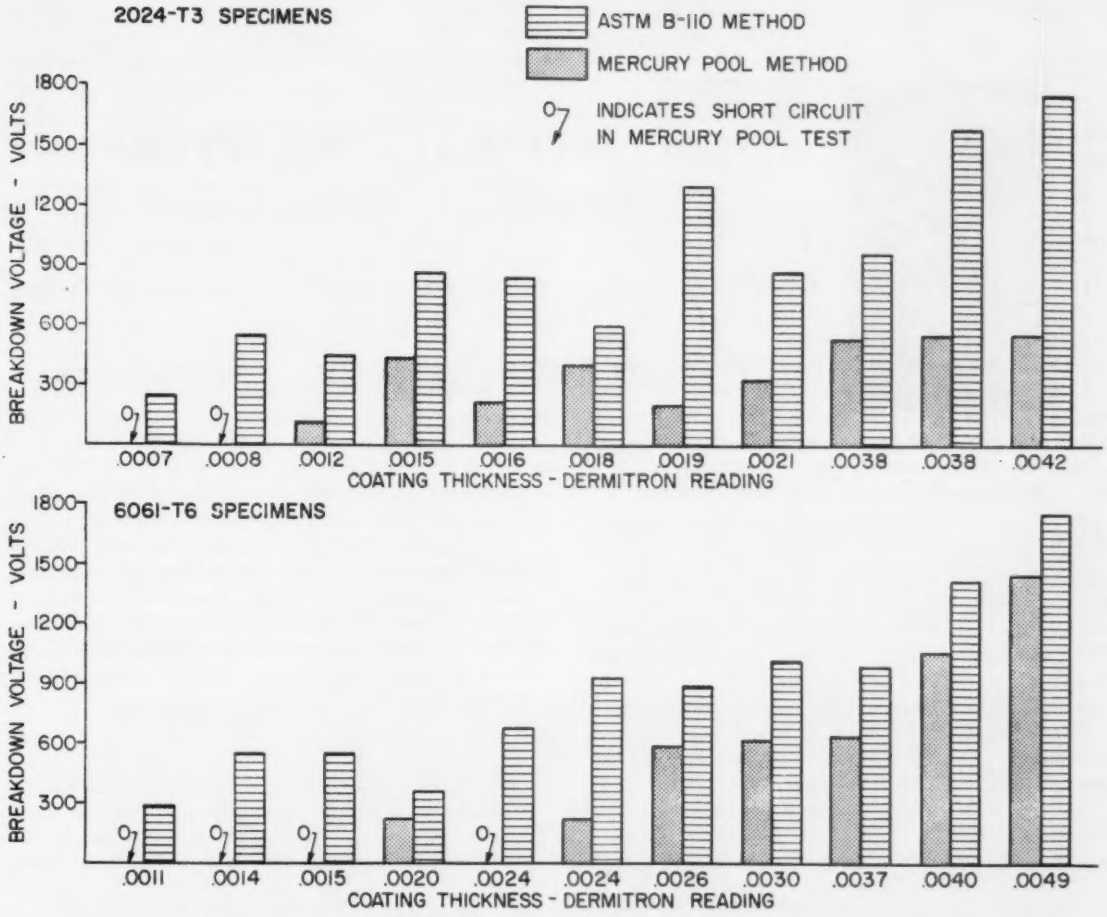


FIG. 3 - MERCURY POOL AND ASTM B-110 BREAKDOWN VOLTAGES FOR THE SAME SPECIMEN

was not investigated, it is believed that abrasion results are useful as process quality control standards.

Dielectric strength breakdown voltages tend to increase with increase in coating thickness. Breakdown voltages were considerably lower under mercury pool test conditions than under ASTM B-110 test conditions, indicating presence of localized zones of low dielectric strength. Coatings for dielectric strength are best evaluated under service conditions on actual parts, rather than test panels.

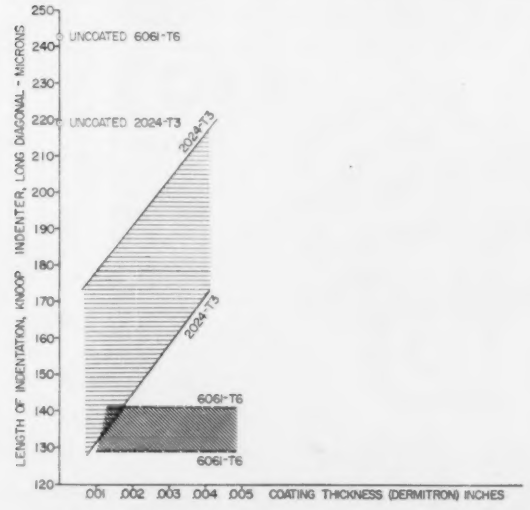
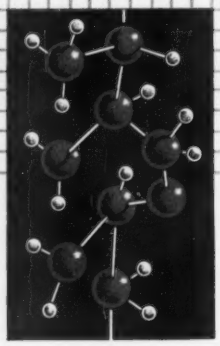


FIG. 4 - COATING THICKNESS VS. KNOOP INDENTER INDENTATION VALUE

Knoop indenter penetration readings were found to be useful in evaluating coatings. Indentations are larger for coatings on 2024-T3 than for coatings of equivalent thickness on 6061-T6. Indentations for 2024-T3 specimens tend to increase sharply with increase in thickness of coating. There is an indication that indentation values can be correlated with the results of abraser tests.

Anodized specimens were superior to non-anodized specimens in appearance after salt spray testing. However, corrosion protection depends on continuity of the coating rather than thickness of the coating. The 2024 alloy was apparently more difficult to anodize with a continuous coating than the 6061 alloy, resulting in generally inferior corrosion resistance under salt spray conditions. Development of a non-destructive, convenient test for evaluating coating continuity will be helpful in establishing suitability of parts for service where maximum resistance to corrosion is required.



SYNTHETIC RESINS

The Backbone of Modern Finishes

A SURVEY OF THE LATEST DEVELOPMENTS IN SYNTHETIC RESINS USED IN COATINGS

Part VI - Epoxy Resins (Section B)

By Harold P. Preuss

Additional Sources of Epoxy Resins

IN foregoing articles we discussed the preparation and general properties of epoxy resins. Actually, like other synthetic resins, epoxies are made from basic building blocks supplied by nature. From these are derived the various elements needed to combine chemically with one another to produce new materials not found in nature. This is illustrated in Fig. 1. We also discussed in the previous article epoxy resins manufactured by Ciba Products Corporation, Reichhold Chemicals, Inc., and the Dow Chemical Company for use in formulating protective coatings.

In this article we will describe the epoxy resins made for this purpose by Jones-Dabney Co., Division of Devoe and Raynolds Co., Inc. of Louisville, Ky.; Shell Chemical Company, Plastics and Resins Division, New York, N. Y.; Union Carbide Chemicals Company and Union Carbide Plastics Company, New York, N. Y.; Minnesota Mining and Manufacturing Company, Chemical Division, St. Paul, Minn.; and Chemical Division, General Mills, Inc., Kankakee, Ill. Also mentioned are seven other producers of resinous products based in some cases on the epoxy products of the above companies.

Jones-Dabney Resins

This company was one of the pioneers in the United States in the field of epoxy resins. As a result, they offer a wide range of epoxy products for use in the protective coatings industry. Table 1 lists these resins

TABLE 1

Typical Applications for Jones-Dabney Epoxy Coating Resins

Resin	*Typical Use*
Epi-Var 100	Floor varnish
Epi-Var 109	Non-smudging, leafing aluminum vehicle
Epi-Tex 101	Fast drying, clear varnishes
Epi-Tex 120	Chemical resistant industrial air drying and baking enamels
Epi-Tex 132	Aluminum vehicle, excellent leafing and non-smudging
Epi-Tex 183	Chemical resistant industrial air drying and baking enamels
Epi-Tex 186	Slow-cut Epi-Tex 183 for brush or roller coat application
Epi-Tex 199	Fast drying clear varnish and enamel
Epi-Tex 1311	Hammer finishes
Epi-Tex 1341	Air dry and bake roller coating enamel; maintenance finishes
Epi-Tex 1486	Metal decorating finishes, air dry and bake
Epi-Rez 504	Thixotropic chemical resistant clear coatings
Epi-Rez 510	Maintenance finish primers
Epi-Rez 520	Chemical resistant coatings, maintenance finishes
Epi-Rez 522	Chemical resistant coatings, maintenance finishes
Epi-Rez 530-C	Chemical resistant coatings, maintenance finishes
Epi-Rez 540	Room temperature or heat converting chemical resistant coatings
Epi-Rez 550	Room temperature or heat converting chemical resistant coatings
Epi-Rez 201	Chemical resistant baking finishes
Epi-Rez 202	Chemical resistant baking finishes
Epi-Rez 242	Chemical resistant coatings, maintenance finishes
Epi-Rez 285	Used with catalyst for chemical resistant air drying or low temperature baking finishes.
Epi-Rez 2036	
Epi-Rez 2047	

with their uses. Other epoxy resins made by this same company find use as adhesives, laminates, etc. In Table 2 are shown the properties of seven of these resins. These represent the basic 100% non-volatile liquid and solid epoxy resins made by Jones-Dabney.

Shell Resins

Eleven types of basic epoxy resins are available from Shell Chemical for formulation into coatings, adhesives, castings and laminates. The primary difference among the various types of these resins is molecular weight, which increases as the identifying number increases. Ten resins are considered applicable for use in protective coating formulations:

EPON 812 is the most reactive resin. In certain formulations it may be blended in small amounts with other epoxy resins to lower their viscosity when a thin consistency is desired.

EPON 820 and EPON 828 are pourable liquids at room temperature. The former is preferred in applications where the handling characteristics of a low viscosity resin are indicated. EPON 828 may be recommended for applications where a higher viscosity resin can be tolerated.

EPON 834 and EPON 836 are viscous materials readily pourable only when heated slightly above room temperature. They may be used alone or modified with other epoxy resins.

EPON 1001, a solid resin which softens slightly above room temperature, is widely used in surface coating applications where solutions of this resin are the preferred vehicles for amine-cured coatings. Such paints have excellent chemical resistance and durability and find wide use in maintenance applications.

EPON 1002, a solid resin with a slightly higher melt point than EPON 1001, is generally acceptable for use as a direct replacement for the latter. The higher melt point improves the storage characteristics of this resin as compared to EPON 1001 in that there is a lesser tendency for the flakes to "block" or fuse together when stored at elevated temperatures.

EPON 1004 is used primarily in preparing ester-type surface coating vehicles for use in floor varnishes, metal finishes, appliance primers, industrial primers and maintenance paints. These coatings combine excellent flexibility, adhesion and toughness with good chemical resistance properties.

EPON 1007 and EPON 1009 are generally blended with urea-formaldehyde and phenol-formaldehyde resins to produce vehicles for bake-type surface coatings. These coating systems, which produce films with outstanding flexibility and adhesion as well as exceptional

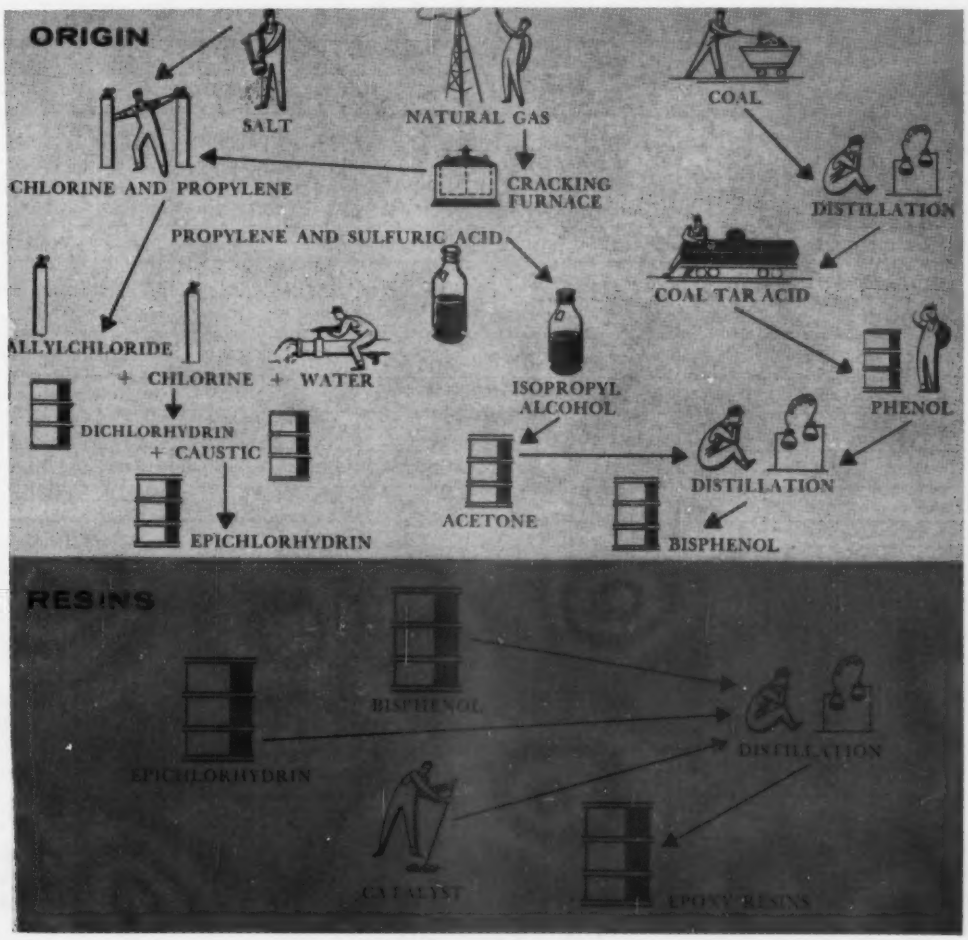


Fig. 1. Sources of Epoxy Resins.

TABLE 2

Properties of Unmodified Types of Epoxy Coating Resins *

MFR.	TYPE OF RESIN	LIQUID OR SOLID	VISCOSITY GARDNER-HOLDT	SP. GR. LBS./GAL.	EPOXIDE EQUIVALENT ①	CHLORIDE %	MELTING PT. (DURANS) °C.	COLOR (MAX.) (GARDNER '33)
JONES-DABNEY	EPI-REZ 504	LIQUID	E-H	9.2	170-180	–	–	3
	EPI-REZ 510	LIQUID	Z_5-Z_6	9.7	180-200	–	–	3
	EPI-REZ 520	SOLID	–	–	450-525	–	65-75	3②
	EPI-REZ 522	SOLID	–	–	550-650	–	75-85	3②
	EPI-REZ 530-C	SOLID	–	–	860-1015	–	95-105	3②
	EPI-REZ 540	SOLID	–	–	1600-2000	–	127-133	4②
	EPI-REZ 550	SOLID	–	–	2400-4000	–	145-155	4②
SHELL	EPON 812	LIQUID	–	–	140-160	–	–	3
	EPON 820	LIQUID	–	–	180-195	–	–	8
	EPON 828	LIQUID	–	–	180-195	–	–	5
	EPON 834	SEMI-SOLID	O-V	–	230-280	–	–	5③
	EPON 836	SEMI-SOLID	A_1-B	–	280-350	–	40-45	5②
	EPON 1001	SOLID	D-G	–	425-550	–	65-75	4②
	EPON 1002	SOLID	G-K	–	550-700	–	75-85	4②
	EPON 1004	SOLID	Q-U	–	875-1025	–	95-105	4②
	EPON 1007	SOLID	Y-Z_1	–	2000-2500	–	125-135	5②
	EPON 1009	SOLID	Z_2-Z_5	–	2500-4000	–	145-155	5②
UNION CARBIDE	ERL-2795	LIQUID	S-U	9.3-9.5	179-194	0.2 (MAX.)	–	6
	ERL-3794	LIQUID	Z_5-Z_6	9.9-10.0	174-186	0.3 (MAX.)	–	5
	ERL-2774	LIQUID	Z_5-Z_6	9.6-9.7	185-200	0.2 (MAX.)	–	5
	EKR-2002	SOLID	C-G	9.7	450-525	–	63-77	6②
	ERRB-0100	SOLID	–	–	190-220	–	85-94	–
GENERAL MILLS	GENEPOXY 175	LIQUID	Z_4 (MAX.)	9.7	172-176	< 0.25	–	1②
	GENEPOXY 190	LIQUID	Z_5-Z_6 (MAX.)	9.8	187-191	< 0.25	–	4②
	GENEPOXY M180	LIQUID	S-U (MAX.)	9.4	177-183	< 0.35	–	4②
	GENEPOXY 525	SOLID	G-J②	9.9	550-550	0.2	74-80	1②
	GENEPOXY 925	SOLID	R-V②	9.9	875-950	0.2	95-103	3②
	GENEPOXY 1800	SOLID	Y-$Z_1$②	9.8	1600-1900	0.2	120-128	1②

① Grams of resin containing one gram-equivalent of epoxide.
② 40% non-volatile in diethylene glycol monobutyl ether.
③ 70% non-volatile in diethylene glycol monobutyl ether.

* The manufactuers listed herein usually supply their solid types of epoxy resins as solutions in various solvents. These are not listed. Data on these may be obtained from the manufacturers.

resistance to chemicals and solvents, find wide usage in tank, drum and can linings, appliance primers, and in clear coatings on brass hardware, lipstick cases, compacts, etc. EPON 1007 is used also in preparing ester-type vehicles for primer applications.

Properties of the above resins are given in Table 2. In addition to these basic resins, Shell also provides EPON 836, 1001 and 1007 in solution form for ready use by the formulator of protective coatings.

(*To be continued*)

Science for Electroplaters

63. Nickel Plating

By L. Serota

THE extensive use of nickel as an electrodeposited coating is ascribed to such favorable characteristics as: corrosion resistance, pleasing appearance, mechanical properties, ease of deposition. The attractive luster of nickel plating, when applied for decorative purposes on metals subject to corrosion, such as steel, brass, zinc-base die castings and light metal alloy castings, is enhanced when thin films of chromium (about 0.00002″), or in some instances gold, silver, or platinum, is plated over a bright nickel surface. Otherwise, C. H. Sample notes, fogging of the nickel surface will occur upon exposure to industrial atmospheres. The nickel deposit, at times, is preceded by a layer of copper.

The corrosion resistance of a nickel coating is due to the fact that nickel is cathodic to most of the basis metals. The thickness of the nickel deposit will govern the degree of freedom from pores which, in turn, relates to the corrosion resistance. For example, W. A. Wesley and W. H. Prine suggest, for a good finish for high quality plumbing fixtures, a nickel deposit, 0.0005″ thick; for outside hardware, 0.0015″; for steel metal furniture, 0.00075″ indoors, and 0.0015″ outdoors. For auto bumpers (on ferrous metal) 0.002″ to 0.003″ of nickel thickness is recommended.

E. J. Seyb, Jr., on the other hand, shows that a thicker coating of chromium (a finely cracked chromium deposited on top of crack-free chromium) is more effective for preventing corrosion than increasing thicknesses of copper and nickel. The following results were reported for two tests on steel automobile grille sections: (1) copper 0.4 mil; nickel 0.8 mil; chromium 0.01 mil (ordinary). The rate of attack by the copper-accelerated acetic acid salt spray test (CASS test) in 48 hours was 10-25 per cent corrosion. (2) copper 0.4 mil; nickel 0.8 mil; chromium 0.20 mil, 50/50. Corrosion with CASS test, in 325 hours, was less than 0.1 per cent.

Watts Bath

It is significant that, although the introduction of nickel plating dates back somewhat over 100 years, with the first commercial bath introduced about 1869 (generally accredited to I. Adams, who used a bath containing the double sulfate and chloride salts), the nickel plating solution introduced by O. P. Watts in 1915, the forerunner of rapid plating at higher temperatures, remains essentially unchanged.

G. Dubpernell attributes the continued use of the Watts bath for over 40 years to the fact that it provides the best base for modern bright nickel solutions. The extent of nickel electrodeposition from the Watts bath is indicated statistically by W. M. Phillips, in space age terms, when he notes that the total amount of nickel so produced would form a path of nickel 3 feet wide and 0.0003 inch thick sufficiently long to reach from the earth to the moon and back again.

The development of the Watts bath represents the effort made by O. P. Watts to obtain results with a nickel solution comparable to the impressive results H. T. Kalmus and associates reported with a cobalt bath. The cobalt solution, consisting of 312.5 g./l. $CoSO_4$ (anhydrous), 19.6 g./l. NaCl and enough boric acid to give a saturated solution, when operating at a high current density of 150 amp./ft.^{2}, produced a high grade commercial (cobalt) plate in 3 minutes, even at room temperature. This represented a speed of about 15 times that then obtained with the fastest nickel plating solution. This solution is known as the X111-B (cobalt) solution.

The satisfactory results shown by the Watts nickel plating solution forestalled the substitution, which was taking hold in commercial processes, of cobalt for nickel, and elicited the comment from C. G. Fink, during a discussion period, "Now Dr. Watts comes forward and saves the day for nickel." G. B. Hogaboom noted during this same discussion period, as examples of some drawbacks in the use of cobalt, that the cobalt solution cannot produce a white deposit obtainable with nickel; the deposit stains rapidly, and cobalt deposits on electrically heated units will tarnish readily, with the tarnish difficult to remove. In respect to rapid nickel plating, a difficulty Hogaboom indicated was the fact that the hot solution becomes rapidly alkaline, giving a dull deposit.

The solution Watts prepared consisted of nickel sulfate, 240 g./l. (32 oz./gal.); nickel chloride, 20 g./l. (3 oz./gal.); boric acid, 20 g./l. (3 oz./gal.). Higher concentrations are used now. A representative formula may be given as $NiSO_4 \cdot 6H_2O$, 300 g./l. (40 oz./gal.); $NiCl_2 \cdot 6H_2O$, 60 g./l. (8 oz./gal.); boric acid 38 g./l. (5 oz./gal.). Such increases account for the greater limiting current density permissible and lower resistance in the bath which, in turn, serves to improve plate distribution. Electroplating was conducted at 125 to 150 amp./ft.^{2}, at which current density range Watts obtained a deposit in 5 minutes, heavier and superior in quality and adhesion to that obtained theretofore from the rapid baths then operating at 10 amp./ft.^{2} for one hour.

One of the experiments Watts cites as evidence of the benefits of hot nickel baths was a solution containing 10 oz./gal. of the double sulfate operating at a temperature of 194°F. and a current density of 29 amp./ft.^{2}. A good deposit was obtained in 20 minutes, whereas, comparable deposition from a cold solution operating at the usual current density of 3 amp./ft.^{2} would require 3½ hours.

A maximum current density of 1257 amp./ft.^{2}, used during this investigation for rapid nickel plating, with a ¾ inch diameter brass cathode rotating at 1000 rpm, gave excellent results. The heavy deposit obtained in 2 minutes at this current density, and polished in 2 to 3 minutes with tripoli and rouge, is equivalent, Watts stated, to 14 hours at 3 amp./ft.^{2}. An efficiency of 99.8% for the deposition of nickel on a rotating cathode at 625 amp./ft.^{2} was also reported.

A significant phase of the hot solution, in addition to speed of deposition, is the softness, toughness, and freedom from peeling of the deposit so obtained. The hardness of thick nickel deposits from cold solutions,

TABLE I

Deposits on Aluminum

Exp.	Temperature C°	Temperature F°	Time Min.	Amperes per Sq. Dm.	Amperes per Sq. Ft.	Ampere-Hours per Sq. Ft.	Deposit
No. 12	74	165	20	18.9	176	60.3	Fine, matte
No. 14	35	95	12	11.7	109	22.6	Rolled up, brittle.
No. 15	38	100	22	8.2	76	27.9	Matte, torn in buffing.
No. 49	71	160	5	24.2	225	18.7	Fine.
No. 50	78	172	10	30.7	285	47.6	Fine.
							0.002 inch (0.05 mm.) thick.
No. 53	98	208	25	15.2	141	60	Five successive deposits.

Watts notes, introduces a greater difficulty in buffing, requires more time, and shows a greater tendency to peel than thin deposits. The results of a comparative study of the effect upon nickel deposits with hot and cold solutions is indicated in Table 1. Polished aluminum was used as cathodes, from which the deposited nickel could be stripped readily.

Deposits from the hot solution, when removed from aluminum, exhibited good physical qualities and withstood polishing without peeling. In run No. 53, in the table, the five successive deposits were made at 5 minute plating cycles, with each coating polished and immersed in the electrolytic cleaning bath for 10 seconds before the additional coat was applied.

Nickel Sulfate

The salt nickel sulfate, $NiSO_4 \cdot 6H_2O$, is the principal ingredient in the Watts bath, providing the required nickel ion for electroplating. Its use is preferred because it is available at a relatively low cost, and contains uncomplexed nickel ions and a stable (sulfate) anion, which is not reduced at the cathode or oxidized at the anode. This single salt has the added advantage of greater solubility (460 g./l., room temperature, 570 g./l., at 50°C.) compared to the lower solubility of the double nickel salt, $NiSO_4 \cdot (NH_4)_2 SO_4 \cdot 6H_2O$, nickel ammonium sulfate (102 g./l., room temp., 175 g./l., 50° C.) used in the earlier nickel baths. The increase is nickel ion concentration, resulting from the greater solubility of nickel sulfate, increases the limiting cathode current density and reduces the resistivity of the bath.

In the dissolution of nickel sulfate, a strong electrolyte, the assumption is made that dissociation is complete at all concentrations. To account for the reduction in equivalent conductance at appreciable concentrations, the Debye-Hückel-Onsager theory ascribes such changes (decreases) in ionic mobility (velocity) to interionic forces. The magnitude of such interionic attraction is a function of the concentrations and valence which, at a given temperature, will increase with increase in valence of the ion and concentration of the solute. These two influences, especially for solutions containing 2 or more strong electrolytes, are indicated by the term ionic strength, introduced by G. N. Lewis and defined as one half the sum of the product of the concentration of each ion present in solution, multiplied by the square of the valence.

The indicated attractive force between ions is associated with the combined effect of: (a) the electrostatic forces (governed by Coulombs Law) between ions of opposite charges, as for example, the positive central metal ion, which is considered as surrounded by ionic atmosphere of charged particles of opposite sign, such as the negative sulfate ions; and (b) the thermal agitation or movement of the ions. An applied external potential will cause the central ions to move from the center of the ionic atmosphere toward the opposite direction. A frictional force is exerted by the solvent.

Ion Association

The concept of ion association, introduced by Bjerrum, refers to the formation of ion-pairs resulting from the electrostatic attraction when ions of opposite charges are sufficiently close.

This, in effect, represents undissociated molecules without covalent linkage. Complete ionization, but not complete dissociation of the electrolyte may result. Ionization and dissociation are both complete, however, when solutions are very dilute. Current is carried, accordingly, by the portion of the electrolyte present as free ions and not by the unionized and undissociated ions.

For dissolved nickel sulfate, the formation of the ion-pair $(Ni^{++}SO_4^{=})^0$ is indicated by E. B. Saubestre, by the following equations: $NiSO_4 \cdot 6H_2O$ (crystal) $\rightarrow NiSO_4$ (aq.) $\rightarrow (Ni^{++} SO_4^{=})^0$ (aq.) $\rightarrow Ni(H_2O)_4^{++} + SO_4(H_2O)^=$ The presence of triple ions resulting from the interaction of a simple ion with an associated ion-pair,

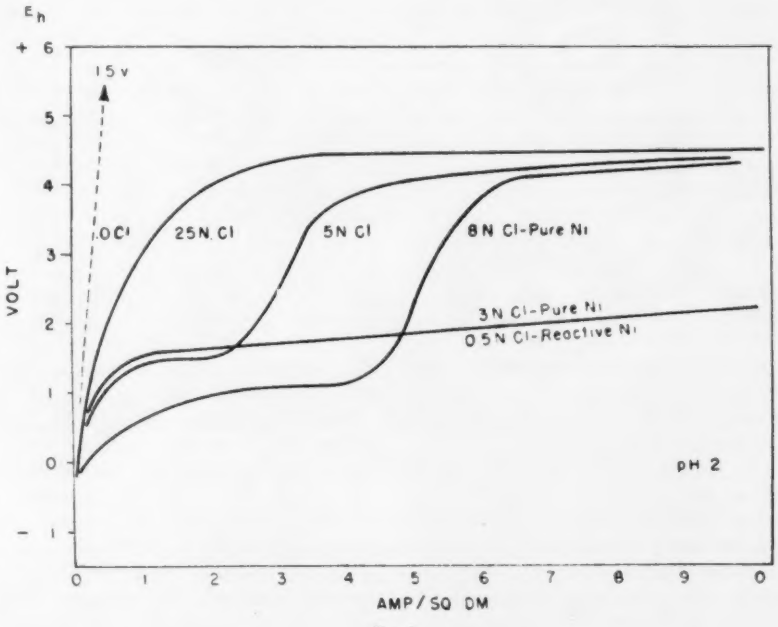


Fig. 1

		Relative Population	3d	4s, 4p
Atom Cores in Metal	[Ni]	4	●● ●● ●	○○
	[Ni°]	6	●● ●● ○	○ ●
	[Ni°°]	Few	●● ●○ ○	●
Ions in Sol'n	$(Ni^{00}\cdot xH_2O)^{++}$		●● ●○ ○	x ●
	$(Ni^{00}\cdot yH_2O\cdot Cl^-)^+$		●● ●○ ○	y ●

Fig. 2

$(+ - +)$ or $(- + -)$, due to Coulomb forces, was suggested by C. A. Kraus, based upon increased equivalent conductance values with increasing concentration, obtained in solvents of low dielectric constant. A minimum in conductance is first obtained, indicating the presence of neutral ion-pairs. At higher concentrations, however, Kraus notes, increasing conductance is explained by the formation of triple ions as carriers of current.

Quadrupoles may also form. The equation representing such ion formation (triple ions and quadrupoles) with nickel sulfate is given by Saubestre as follows:

$(Ni^{++}SO_4^{=})^0 + Ni(H_2O)_4^{++} \rightarrow (Ni^{++}SO_4^{=}Ni^{++})^{++}$ (aq.); $(Ni^{++}SO_4)^0 + SO_4(H_2O)^{=} \rightarrow (Ni^{++}SO_4^{=}SO_4^{=})^{=}$ (aq.)

$2\,(Ni^{++}SO_4^{=})^0$ (aq.) $\rightarrow$

$$\begin{bmatrix} Ni^{++}SO_4^{=} \\ SO_4^{=}Ni^{++} \end{bmatrix}^0 \text{(aq.)}$$

For solvents of high dielectric constant, such as water, the effect, Saubestre notes, favors the presence of a cloud of oppositely charged rather than associated pairs, triplets or quadrupoles.

Electrodeposition of nickel therefore, must take into account the activity of the ion, a term which refers to the effective concentration of an ion at the cathode surface, which approaches unity at infinite dilution. The correction factor, activity coefficient, is introduced because, with increasing concentration, the value becomes less than one, since most ionic substances depart from the effective concentration because of interionic attraction.

Nickel Chloride

The chloride ion, present in the Watts bath by the addition of nickel chloride, aids anode dissolution (corrosion) by markedly inhibiting, Glasstone states, the onset of passivity. Solution of the anode will begin, he notes, when the theoretical reversible potential of the electrode is more than 0.3 to 0.4 volt, at ordinary temperatures. This polarization (irreversibility) is attributed to a slow stage during the anode electrode reaction. Anode efficiency, however, is not affected by polarization, remaining close to 100 per cent unless chlorides are absent.

The polarization curves obtained by W. A. Wesley (Fig. 1) for various chloride concentrations in a Watts nickel bath, 55°C., indicate the rise in potential, to 0.4 volt with pure nickel. With zero chloride concentration, the anode potential rises to 1.5 volts (dotted line on left of graph), oxygen is liberated, and anode efficiency is reduced appreciably. A chloride concentration as low as 0.25N, Wesley states, is sufficient to provide good anode efficiency from a hot solution at 10 amp./dm.^{2}, even at a pH of 5.

A significant phase of the so-called, "intermediate" type of passivity occurring at the 0.4 volt state, Wesley notes, is the rough corrosion affecting the pure nickel anode. A spongy surface of metallic nickel results, with loose particles set free.

When the pure nickel anode dissolves at potentials below +0.25 volt, however, corrosion is smooth. Wesley associates this spongy surface condition at the higher potential to the selective removal of surface (Ni^0) atom core, whereas both (Ni) and (Ni^0) atoms dissolve at about the same rate at the lower potential.

The bracketed symbol (Ni^0) represents a nickel atom core in the metal lattice with one vacancy, shown as circle, in the 3d level of the M shell, and the symbol (Ni) a nickel atom with no vacancies in the 3d level (Fig. 2). The 4s and 4p electrons, solid dots, are not included in the atom core. The third type of electron arrangement for the nickel atom core (Ni^{00}) with 2 vacancies in the d level, the form required for hydrated nickel ions, is present in relatively small amounts. Polarization and passivity are attributed to vacancies in the d-band.

The chloride ion, it is suggested, forms an adsorption complex with the (Ni^0) atom core represented as $(Ni^0)\cdot Cl^-\cdot H_2O$, which changes to the complex cation $(Ni^{00}\cdot yH_2O\cdot Cl^-)^+$, thus enabling directly solution of the surface (Ni^0) atoms instead of first converting to the (Ni) atom, a change that occurs in the absence of chlorides. E. H. Lyons refers to the formation of this latter mixed complex, a change involving electron transfer, as a bridge-complex. The formula indicated is $[Ni(Cl)^-(H_2O)_3]^+$.

The aquo and chloro complexes indicated in Fig. 2 represent the reaction products formed in the process of ionization and solvation resulting from the rearrangement of the electronic structure in the 3 nickel atom cores. The number of water molecules associated with the nickel ion in solution (aquated ions) corresponds probably to coordination numbers four $Ni(H_2O)_4^{++}$ and six $Ni(H_2O)_6^{++}$. The assumption is made by Lyons that deposition occurs from the tetraquo (coordination number 4) with the activated complex existing largely as $Ni(H_2O)_3^{++}$.

The effect of the chloride ion upon cathode current efficiency was found by E. B. Saubestre to be of negligible value for current densities less than 60 amp./ft.^{2}. At higher current densities, however, the presence of the chloride ion will increase the limiting current

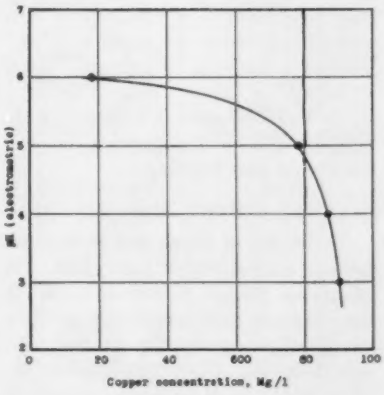


Fig. 3

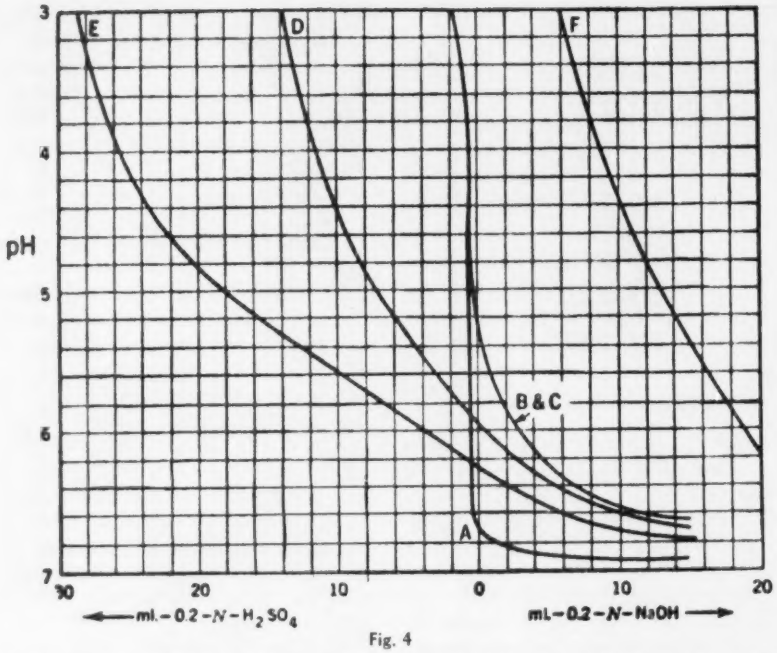


Fig. 4

density at the cathode. Although W. A. Wesley and E. J. Roehl found previously that cathode current efficiencies increased slightly even at low current density with increasing chloride concentration, the comparison, Saubestre indicates, is not conclusive, since many variables, such as pH and nickel concentration, as well as the sulfate-chloride rates, were included in their investigation.

In a study of the effect of variations, such as current density, temperature, and pH, upon the composition of the cathode film with nickel solutions of different composition, A. K. Graham and associates found that the pH of the cathode film was greater (more alkaline), but not beyond limits of tank control, than that of the bath; and, the decrease in chloride ion concentration in the film was greater than the decrease in nickel ion concentration. For example, a variation in current density from 20 to 80 amp./ft.^{2} showed a decrease in range of nickel from 4.1 to 9.9 per cent. This relatively large decrease in chloride in the cathode film, it is suggested, may be associated with burning.

Boric Acid

Variations in anode and cathode efficiencies in a Watts nickel bath will affect the pH of the solution. When the cathode efficiency exceeds the anode efficiency, acidity of the solution increases (lower pH), due, W. Blum and G. B. Hogaboom indicate, to the liberation of sulfuric acid at the anode. If the anode efficiency is slightly higher than that of the cathode, an increase in pH (lower acidity) will result. An increase in pH in the cathode film may cause preciptation of nickel hydroxide or other basic compounds, a cause of burnt deposits. W. L. Pinner and associates record the following pH values at which metal hydroxides will preciptate: iron (ferric) hydroxide, 4.0; zinc hydroxide, 5.5; nickel hydroxide, 6.5; copper hydroxide, 6.3.

The effectiveness of removing copper as an impurity from a Watts type, gray-nickel bath, pH 2.5, by increasing the pH (by precipitation) was demonstrated by D. T. Ewing and associates. The bath, containing 87 parts per million (ppm) or 87 milligrams per liter (mg/l) was treated with nickel carbonate. When the pH of the solution was up to 6.0, it was filtered and analyzed for copper content. Analysis showed that 13 ppm of copper remained. This treatment, however, will result in a loss of nickel. Results are shown graphically in Fig. 3. Electrolytic removal of copper gives the lowest remaining copper concentration.

To overcome changes in pH in the bath, when relatively small differences in anode and cathode efficiency occur, the solution is buffered by the addition of boric acid. The buffering action serves to resist changes in pH upon the addition of an acid or alkali. Boric acid, H_3BO_3, is effective as a buffer in the nickel plating solution because it is a weak acid, hence, slightly ionized, with a dissociation constant as low as 5.8×10^{-10}. The ionization equation for (ortho) boric acid is as follows: $H_3BO_3 \rightleftarrows H^+ + H_2BO_3^-$. When the concentration of the boric acid is 0.5 molar or more, the tetraboric acid molecule, $H_2B_4O_7$, which is a stronger acid than the orthoboric acid, H_3BO_3, forms: $4H_3BO_3$ (orthoboric acid) $\rightarrow$ $H_2B_4O_7$ (tetraboric acid) $+ 5H_2O$. Tetraboric acid yields the tetraborate ion $HB_4O_7^-$: $H_2B_4O_7 \rightleftarrows H^+ + HB_4O_7^-$.

In a Watts nickel bath, boric acid may be used as a buffer when the pH is 5, as well as for solutions having a pH of 4. E. B. Saubestre interprets the buffering action of the boric acid at the higher pH to the acid forming a complex with nickel. In such cases the boric acid does not act as a buffer.

When the pH of the Watts bath is 2, the buffering action of the boric acid is limited to the cathode film, where the pH is higher than that in the rest of the bath. L. P. Hammond, who considered maintaining of a constant acidity (buffering) in the nickel bath the principal function of the boric acid, found that good nickel deposits were also obtained when such acids as citric, acetic, benzoic, and salicylic were used in place of boric acid.

The buffering action of boric acid is effectively demonstrated by the titration curves shown in Fig. 4, which represent changes occurring in pH when 50 ml. of nickel solutions of different compositions are titrated with 0.2N H_2SO_4 and 0.2N NaOH. Curve A, for example, representing a normal (N) nickel sulfate solution, requires little acid (or alkali) to change the pH between 4 and 6. Curve B represents the titration curve for a solution containing 1.0N $NiSO_4$ and 0.5M H_3BO_3; and curve C is the titration curve for a solution containing 0.2N NaCl in addition to 1.0N $NiSO_4$ and 0.5M H_3BO_3. Curve D, it will be noted, requires as much as 12cc of 0.2N NaOH to raise the pH from 4 to 6. This solution consisted of 1.0 $NiSO_4$, 0.5M H_3BO_3, 0.1N NaF. The addition of fluoride, it is believed, improves the buffering action by the formation of complexes of fluoboric acid. The curves E and F represent compositions similar to that for the solution for curve D, with solution E containing a higher concentration, 0.2N sodium fluoride, and curve F 0.1N HF instead of the salt NaF.

SHOP PROBLEMS

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Standard Hardware Finishes

Question: We are seeking information concerning two metal finishing specifications, U. S. #10 bronze and U.S. #26 chrome. If you have these specifications or any information as to how they may be obtained, would you please advise us.

A. J. R.

Answer: U.S. #10 Bronze finish is a dull bronze, applied to iron, steel, wrought bronze, and cast bronze. U.S. #26 is polished chromium over nickel.

These are hardware finishes, as per Federal specification FF-H-106a, obtainable from the General Services Administration, Washington 25, D. C. at 25c per copy. Standard samples of these finishes are available from the National Bureau of Standards, at cost, but only in complete sets.

Bright Stripping Gold

Question: I need information on bright stripping gold and cannot find any information in your book. I would appreciate information on the following also:

1. After getting a bright strip, how do I get the gold out of the liquid into either a solid form or grains without too much loss?
2. How long does a good strip solution usually last?

Please answer as soon as possible.

L. B.

Answer: Formulas for "bright stripping" gold alloys will be found on page 270 of the 1960 edition of the METAL FINISHING GUIDEBOOK, along with operating details.

If you use a stainless steel pot, which is made the cathode, the dissolved gold will plate out on the walls in sheets which can be detached easily.

The life of a strip will vary with operating temperatures, types of gold alloys, and amount of work. However, the cost is low, so that long life is not important. The strip is replenished with sodium or potassium cyanide and, when the action deteriorates, any remaining gold in the bath can be plated out using a sheet of stainless steel as the anode.

White Pickle

Question: Please send us any books containing information on the white pickle finishing of s/s and construction of tanks for use with pickling solutions.

D. W. M.

Answer: "White pickles" for stainless steel are scale loosening baths. A typical bath would contain 10% by weight sulfuric acid and 2-10% hydrochloric acid, operated at 140-180° F. At the lower temperature, rubber or plastic lined tanks will be suitable, but acid brick linings will be required for operation at 180°F.

Information on various pickling baths for stainless steel and tank construction will be found in the 1960 edition of the METAL FINISHING GUIDEBOOK.

Hard Chromium on Zinc

Question: I am very much interested in some literature on the process of hard chrome plating zinc die cast. If this information is available, it would be greatly appreciated if you would send it to me, at your earliest convenience.

P. M. A.

Answer: Hard chromium can be deposited directly on a cleaned zinc base die casting, but the deposit will be dull. If a bright deposit is required, the zinc base should be copper plated before chromium is applied. Because the basis metal is much softer than chromium, heavy deposits will tend to crack.

Information on the solution and operating conditions will be found in any recent edition of the METAL FINISHING GUIDEBOOK.

Finishes for Steel

Question: For quite a few years we have been trying hard to get a good finish of our set screw line. After heat treating, we apply a black oxide finish — as per attached samples. We are looking for a better process which will improve the appearance of our product and also, if possible, give us more protection against corrosion or deterioration in the appearance of the products when they are staying on the shelf for a year or two.

H. L. G.

Answer: The only commercial alternatives to black oxide finishes would be phosphating or zinc plating.

Phosphate coatings do not have as pleasing an appearance as black oxide but will have more protective value, especially if oiled or waxed. Zinc plating will be more expensive but will also produce the best finish.

Coloring Zinc Gray

Question: We wish to produce a medium gray color on zinc die castings by a dip process, not using electrical deposition. Is any such coating available? Sample of color desired is enclosed, but final color could deviate a little from this sample. We know black is possible, but we want gray

V. H. S.

Answer: A steel gray color can be applied to zinc without current by arsenic displacement. Two formulas suggested in the literature can be tried:

1. White arsenic	6	oz./gal.
Disodium phosphate	2	"
Potassium cyanide	10	"
Room temperature or slightly warm		
2. White arsenic	¼	oz./gal.
Copper sulfate	¾	"
Amonium chloride	⅛	"
Hydrochloric acid	½	pint/gal.
Room temperature		

Sealing Anodized Aluminum

Question: Can you assist us with information on a dye absorption test to be used for determining the effectiveness of the hot water seal for anodized aluminum. We understand there is a standard method specified for this test.

L. A.

Answer: The commonly specified test is A.S.T.M. Designation B136-45, which involves application at room temperature for five minutes of a solution of one gram Anthraquinone Violet R in 50 ml. water. The dye is washed off and the spot rubbed with soap and water. Presence of color in the surface indicates improper sealing.

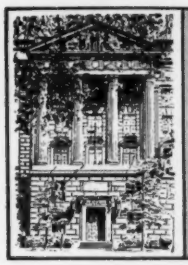
Recent studies have suggested that this test only indicates whether or not the surface has had a sealing treatment, not how effectively it was sealed. A good test consists of immersion at 90°C., for 7 minutes, in 10 g./l. solution of sodium sulfite, adjusted to pH 2.5 with acetic and sulfuric acids. Absence of noticeable bloom indicates proper sealing.

Hydrogen Relief Baking

Question: We have had practically no success when we bake our high strength steel for hydrogen embrittlement relief after cadmium plating. The bake is for four hours at 300°F. and our cadmium deposits are usually 0.0003"thick. We have been informed that application of a very thin deposit, followed by baking, after which the balance of the deposit is applied, will eliminate breakdown in the fatigue test, but our results have not been consistent. Do you consider this double plating method an effective one for minimizing embrittlement?

D. L.

Answer: We know of no completely reliable method for eliminating this condition on a production scale, including the double plating method, although some recovery of strength is generally offered. A Navy study of recovery from hydrogen embrittlement at the 270,000 p.s.i. strength level for AISI 4340 steel, by baking at 300°F., was reported in 1959 by S. V. Chek. Recovery was attained within 4 hours baking if the cadmium deposit was below 0.00013", but was not attained at thicknesses above 0.00025". It was also found that subsequent replating embrittled the steel (Ref: Research Report PB 144 120. Library of Congress).



Patents

RECENTLY GRANTED PATENTS IN THE METAL FINISHING FIELD

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Corrosion Preventive

U. S. Patent 2,956,020. *Oct.* 11, 1960. *J. Suprin and F. Soldano, assignors to Esso Standard Societe Anonyme Francaise*

An anti-corrosion composition comprising: a major amount of hydrocarbon oil; 0.1 to 3 wt. per cent of an alkali metal petroleum sulfonate having a molecular weight in the range of 300 to 600; and 0.01 to 3 wt. per cent of the dehydrated amide reaction product of 2 moles of a C_8-C_{24} fatty acid and one mole of ethylene diamine.

Spray Gun

U. S. Patent 2,956,752. *Oct.* 18, 1960. *F. W. Wahlin, assignor to Spraying Systems Co.*

A spray gun comprising a tubular barrel having a spray nozzle at one end and a handle at the other end, a spray regulator at the nozzle end of the barrel and adjustably cooperable with the nozzle to regulate the spray discharge from the nozzle, a member which is mounted at the handle end of the barrel for movement to and from the handle and has a connection with the spray regulator by which the latter is adjustable to regulate the spray discharge in accordance with the movement of said member to and from the handle.

Sprayed Electroless Nickel

U. S. Patent 2,956,900. *Oct.* 18, 1960. *A. M. Carlson and C. E. Prymula, assignors to Alpha Metal Laboratories, Inc.*

A process of coating a surface with nickel which comprises spraying separately and directing toward the surface so that the solutions converge on the surface a nickel solution and reducer solution, said nickel solution consisting essentially of a nickel salt, selected from the group consisting of nickel sulfate, nickel chloride, and nickel formate; water, and citric acid in a molar ratio of nickel sulphate to citric acid of between approximately 1.3 and 2.0, and a molar ratio of such other nickel salts to citric acid of between approximately 1.3 and 2.85 and said reducer solution consisting essentially of an alkaline solution of sodium hydrosulphite and sodium hypophosphite, the molar ratio of sodium hydrosulphite to sodium hypophosphite being between approximately 1.40 and 3.53.

Tank Lining

U. S. Patent 2,956,915. *Oct.* 18, 1960. *I. Korn, J. S. Kaye, V. C. Pierce, W. Walworth and J. Huscher, assignors to Kaye-Tex Mfg. Corp.*

A special thermo-plastic laminate for the interior walls and floors of tanks for protection against corrosion and abrasion comprising an inner layer of unplasticized polyvinyl chloride and an integral outer layer of plasticized polyvinyl chloride bonded to the interior of the tank, a primer coat being provided on the adjacent faces of the tank and said plasticized polyvinyl chloride layer, and a bonding coat being applied over said primer coats.

Plating Barrel Cylinder

U. S. Patent 2,956,943. *Oct.* 18, 1960. *R. A. Hoegh, assignor to Mercil Plating Equipment Co.*

In an apparatus for treating articles, a barrel comprising end walls and a one piece plastic sidewall, said sidewall including longitudinally extending arcuate sections spaced from one another to provide an article inlet and outlet opening and forming substantially approximately half the periphery of the barrel and said sidewall further including a plurality of angularly disposed tumbling panels between said arcuate sections and substantially completing the remaining periphery of the barrel, said arcuate sections terminating in free marginal portions, one of said marginal portions being located substantially inwardly from the other marginal portion toward the axis of the barrel and providing with the contiguous arcuate section a discrete substantially radial pocket with a generally smooth gradually curved surface merging with the adjacent tumbling panel and operating to trap with reduced agitation articles accumulating therein from the angularly disposed tumbling panels when the barrel is rotating in the treating direction whereby to prevent articles from bouncing out of the barrel through the space between the said marginal portions.

Electroless Copper

U. S. Patent 2,956,901. *Oct.* 18, 1960. *A. M. Carlson and C. E. Prymula, assignors to Alpha Metal Laboratories, Inc.*

The process of coating a surface with copper which comprises mixing together a solution consisting essentially of copper cyanide and a substance selected from the group consisting of 2.0 to 12.0 grams per liter of ethylenediamine tetracetic acid, 2.0 to 12.0 grams per liter of the alkali metal salts thereof, and from 2.0 to 10.0 grams per liter of an alkali metal cyanide, the alkali metal cyanide being present in a molar ratio of alkali metal cyanide to copper cyanide of below approximately 2.89, and a reducer solution composition, consisting essentially of a solution of an alkali metal hydrosulphite, and contacting said surface with the mixed solution.

Pickling Inhibitor

U. S. Patent 2,956,956. *Oct.* 18, 1960. *W. Strauss, A. Kirstahler, W. Gundel and W-D. Willmund, assignors to Dehydag, Deutsche Hydrierwerke G.m.b.H.*

The method of preventing acid corrosion of the metal during the pickling with a mineral acid pickling bath wherein the mineral acid is selected from the group consisting of hydrochloric and sulfuric acids, which consists of adding from 0.01% to 0.5% by weight, based on the amount of mineral acid, of an inhibitor selected from the group consisting of compounds having the general structural formula

$$X—R—SO_3H$$

and their sodium salts, wherein X is a radical selected from the group consisting of chlorine, bromine, iodine, cyanide and thiocyanide, and R is a lower aliphatic radical contaning from 1 to 6 carbon atoms.

Corrosion Preventive

U. S. Patent 2,957,824. *Oct.* 25, 1960. *W. M. Chamot, assignor to Nalco Chemical Co.*

A corrosion inhibitor composition consisting essentially of in proportions by weight about 8-12% of a water and oil dispersible corrosion inhibiting compound, about 8-12% of an unoxidized mineral wax, about 3-12% of a water-insoluble solid alkylene polyamine-fatty acid polyamide dispersant, and a major proportion of a weighting material, in solid stick form.

Gas Plating

U. S. Patent 2,957,779. *Oct.* 25, 1960. *W. M. Bolton, assignor to Union Carbide Corp.*

A masking agent to delineate the contour of the area to be gas plated with metal, said masking agent consisting of a grease composed principally of silicone resin which is heat-resistant and non-hardenable and retains its shape at a temperature of 300°F., and which resin remains in place at a temperature of gas plating the metal thereon.

Coloring Stainless Steel

U. S. Patent 2,957,812. *Oct.* 25. 1960. *R. C. Bongartz and J. M. Beigay, assignors to Allegheny Ludlum Steel Corp.*

The method of coloring stainless steel containing from 10% to 35% chromium comprising, removing all oxide scale from the surface of said steel and imparting thereto at least a No. 2 surface finish, immersing said steel in an aqueous solution that consists essentially of at least one of the alkali metal hydroxides within the range of from about 10% to about 70% at a temperature of from about 60°F. to the boiling temperature of said solution, passing an electric current of a predetermined current density within the range of from about 1/8 ampere per square foot to about 20 amperes per square foot for a predetermined time within the range of from 1 hour to 1 minute while maintaining said steel as the anode therein so as to effect a predetermined color on the surface of said steel without destroying the surface finish, withdrawing said steel from said solution, rinsing said steel with water and drying.

Hot Dip Aluminum

U. S. Patent 2,957,782. *Oct.* 25, 1960. *E. R. Boller, assignor to The Boller Development Corp.*

A process for coating ferrous metal which consists in the steps of cleaning the surface of the work to be coated, then plating the work, in a fused chloride bath which consists of ammonium chloride and at least two chlorides selected from the group consisting of the chlorides of zinc, sodium, potassium, lithium, calcium, magnesium and barium at a temperature between the melting point of the bath and about 650°C., with a nonferrous metal having a solubility in liquid aluminum not exceeding 8% by weight at 700°C., said bath being substantially water-free and oxygen-free and including the chloride of the metal to be deposited on the work in an amount between 0.2% and 3.0% of the mass of the bath, then cleaning heavy metal salts from the work by immersing the work in a bath consisting of fused alkali chlorides and which is free of heavy metals, and then dipping the work in a molten metal bath whose major constituent is aluminum.

Salt Spray Chamber

U. S. Patent 2,957,972. *Oct.* 25, 1960. *R. L. Seidman.*

Wall in a structure for use in conjunction with an electrically heated salt spray fog testing chamber including an outer shell of relatively rigid material, a layer of heat insulative materials disposed upon the inner surface of said outer shell, a blanket of electrically conductive rubber disposed upon said layer of heat insulative material, and a layer of lining material disposed upon said blanket, the same being chemically inert to salt spray.

Automatic Plating Machine

U. S. Patent 2,958,330. *Nov.* 1, 1960. *G. E. Huenerfauth, assignor to Crown Rheostat & Supply Co.*

A stationary track, a trolley line comprising a plurality of sections, a plurality of stations beneath said track including multiple tanks each containing a bath into which work to be processed is immersed, a plurality of work carriers and a lift for each carrier for lowering and raising its carrier at the successive stations, means for moving said carriers horizontally between stations, and means on each carrier for selectively controlling its vertical movement at each station with each lift and its carrier being controlled as a section of the trolley line is energized, and deenergized.

Automatic Plating Machine

U. S. Patent 2,958,331. *Nov.* 1, 1960. *D. J. Borodin, assignor to Allied Research Products, Inc.*

A machine for conveying work pieces along successive treating stations comprising a base, a plurality of tanks arranged as two spaced apart rows, a pair of upright panels on said base extending one along the inner sides of each of said rows of tanks, a carriage movably mounted on said base for reciprocation between said panels longitudinally of said rows of tanks, said base, panels and carriage each comprising a plurality of individual longitudinally extending sections joined together in end-to-end relation, the sections of said base, panels and carriage intermediate the end sections thereof being formed of a uniformly repetitive structural pattern.

Ultrasonic Cleaning

U. S. Patent 2,958,332. *Nov.* 1, 1960. *H. E. Schueler.*

A basket for supporting small bore articles in ultrasonic cleaning tanks having a bottom and side walls defining a plurality of apertures for flow of liquid into the basket on insertion into a tank, a plurality of spaced supporting wires extending upwardly from the basket bottom having at least their upper portion straight, and at least some wires of the plurality having their lower end region wound in an open helix coaxial with a straight upper portion of the wire.

Spray Gun

U. S. Patent 2,958,471. *Nov.* 1, 1960. *B. W. Zippel.*

A spray gun for spraying two media from a single nozzle.

Galvanizing Furnace

U. S. Patent 2,958,520. *Nov.* 1, 1960. *K. Fritz.*

A furnace with a galvanizing pot.

Corrosion Preventive

U. S. Patent 2,958,603. *Nov.* 1, 1960. *D. B. Sheldahl, assignor to Sinclair Refining Co.*

A water-dispersible slushing compo-

LEA

ABRASIVE FINISHING METHODS

STAINLESS STEEL and STEEL

STAMPINGS • CASTINGS • FORGINGS • SPINNINGS

Stainless steel is harder than carbon steel commonly used for forming and on most occasions more time is required to produce a selected finish on stainless steel than the same finish on steel. However, for normal application, the same general procedures are utilized.

Although much progress has been made in the finishing of stainless steels and carbon steel, the production of mirror and high luster finishes is still not easy and the costs are fairly high. On the other hand, attractive semi-bright satin and butler finishes can be obtained at a cost no greater than that required for producing this same finish on other metals. Today, satin or butler finishes are produced on a wide variety of steel or stainless steel articles, the choice being due to the great difference in the cost of production between this type of finish and the high luster finish. Some of these steels, both carbon and stainless, undergo work hardening and physical transformation at relatively low temperatures, thereby complicating polishing and buffing operations.

POLISHING...Polishing is usually done on sewed muslin, canvas, solid leather, sheepskin or felt wheels or abrasive belts at speeds of 6000-8000 sfm. Sometimes five or six polishing operations are employed. The shallower the surface imperfections are, the less coarse need be the first wheel operation and the easier the subsequent removal of scratches left by this wheel. On fairly good surfaces, only one or two of the polishing wheel operations should be necessary. For some types of stainless steel and steel products these operations may be considered a final finish. Polishing wheels may be prepared with **Lea Gripmaster Polishing Wheel Cement** or **Lea Plasti-Glue** and loose abrasives. Liquid **abrasive mixtures** such as **Leabrament** or **Lea Plasti-Brade** are also used in preparing polishing wheels. Lubrication or greasing a polishing wheel or belt can be done with **Lea Lubar** (bar lubricant) or **Lea Liqualube** (liquid lubricant).

FLEXIBLE POLISHING...On curved or irregular surfaces of steel, or stainless steel, flexible polishing with **Grade "E"** or **Grade "E2" Lea Compound** at 6000 sfm on a sewed buff sized with **Ad-Lea-Sive** is used in place of conventional fine set-up wheels to prepare the surface for subsequent cut-down buffing.

SATIN FINISHING...To produce a final satin finish on articles fabricated from rolled stainless steel with good surface characteristics, **Grade "E"** or **Grade "N" Lea Compound** is used on a loose or pocketed type muslin buff at 4500-5500 sfm. In fabricating products from prefinished stainless steel having standard mill finishes, welded or formed areas sometimes require a coarse satin finish to simulate or blend in with the mill finish. **Lea Greaseless Compound Grades 1-K-2 or 1-K-7** are used with **Lea String Wheels** to simulate #3 or #4 mill finishes.

BUTLER FINISHING...To produce this final finish showing no surface defects, use **Grade "B-31" Lea Compound** with **Grade 316 Learok** as a lubricating agent on a sewed, loose or pocketed type muslin buff at 5500 sfm.

BRIGHT FINISHING—(Bar Compositions)...After intermediate flexible polishing with **Lea Compound,** a bright-finish is produced with **Grade 306** or **316 Learok** on a pocketed type buff at 10,000 sfm. For color, use **Grade 302C** or **309 Learok** on the same type wheel and at the same speed.

BRIGHT FINISHING—(Liquid Compositions)...After intermediate flexible polishing with **Lea Compound** or if the stainless steel has a surface in fairly good condition to serve as a base for bright finishing, **Lea Liquabrade** is used.

Grades FH77J or FU49S Liquabrade will cut down minor imperfections and give some color. **Grade UF57A Liquabrade** is for cut and color and recommended where fairly bright finishes are required.

Grade UH20A Liquabrade gives the highest color and is generally used for the last buffing operation.

Speeds of 8000 to 10,000 surface feet per minute are recommended. Ventilated, sewed or loose buffs can be used.

BLENDING AND SIMULATING MILL FINISHES ON STAINLESS STEEL

One current production method for blending in weld marks and removal of tool or die marks is as follows:

The weld bead is first ground down with a #4 grit disc, then with a portable belt machine using an 80 grit belt. The area around the weld is then finished to simulate a #4 mill finish and is produced with **Grade 1-K-2 coarse grit Lea Compound** on a 6" dia. string wheel operated by a heavy duty flexible shaft machine. **Lea Compound** is applied to the string wheel and allowed to dry approximately 5 minutes. The string wheel is then placed against the surface of the stainless steel in a straight line motion to keep the scratch pattern as uniform as is possible. The final operation involves the use of a polishing log made up of **Lea String Wheels** making a total face width of approximately 24". These string wheels are mounted on a shaft with ball bearing handles. After **Grade 1-K-2** is applied to the polishing log, coated thoroughly and dried adequately, two men hold the polishing log and satin finish the entire surface on large areas of the stainless steel item in **one uniform operation.** This **Lea Satin Finish** produced with **1-K-2 Lea Compound** directly on the original 2-B mill finish simulates quite closely the desired #4 mill finish. A periphery speed of 1350 surface feet per minute is used.

Burring, Buffing, Polishing, Lapping, Plating and Spray Finishing Manufacturers and Specialists in the Development of Production Methods, Equipment and Compositions. Manufacturers of Lea Compound and Learok ... Industry's quality buffing and polishing compounds for over 20 years.

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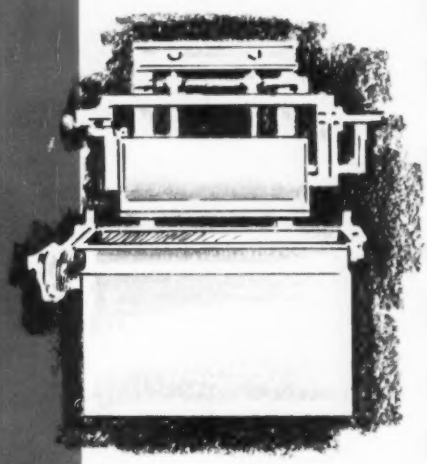
Now, as the result of extensive research, Lea-Ronal offers the brass plater a new, simple, economical, high speed barrel brass plating solution that deposits a uniform lustrous brass color, obtainable in a wide range of operating conditions.

Specifically, this new Lea-Ronal process offers these advantages:



1. **elimination of guess work in barrel brass plating**
2. **permits doubling, even tripling, present production schedules, with existing equipment**
3. **permits this production step-up without encountering problem of non-uniformity of color**
4. **uniform color over wide plating range (0-50 amp./sq.ft.)**
5. **Operating temperature range of 100-140° F**
6. **rapid deposition—rates up to 0.001 inches per hour, depending on barrel and load**
7. **easily controlled, no guessing, chemical addition made on a prepared salt basis.**

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sition consisting essentially of from 5% to 15% by weight of a compound having the formula

$$H(OCH_2CH_2)_nOR$$

wherein *n* is an integer from 1 to 2 and R is a monoalkyl radical having 3 to 8 carbon atoms, from 20% to 30% by weight of sorbitan monooleate, from 2% to 15% ammonium mahogany sulfonate, and substantially the remainder being a mineral oil.

Plating on Aluminum

U. S. Patent 2,958,610. *Nov.* 1, 1960. *E. R. Ramirez and E. F. Barkman, assignors to Reynolds Metals Co.*

In the chemical nickel plating of aluminum and aluminum alloys by the sequential procedure of alkaline etching, pretreat rinsing and chemical hypophosphite plating, the step which consists in pretreat rinsing said aluminum with an aqueous bath consisting essentially of ammonia in the range of about 0.1 to about 30 parts by weight and a complexing agent selected from the group consisting of aminocarboxylic acids, alkaline earth metal salts of aminocarboxylic acids, ammonium salts of aliphatic hydroxycarboxylic acids, aliphatic hydroxycarboxylic acids, alkali metal salts of aliphatic hydroxycarboxylic acids and alkaline earth metal salts of aliphatic hydroxycarboxylic acids in the range of about 0.1 to 5 parts by weight.

Priming of Zinc Surfaces

U. S. Patent 2,958,611. *Nov.* 1, 1960. *E. W. Ulrich, assignor to Minnesota Mining and Manufacturing Co.*

The method of providing a permanent protective finish coat on a clean fresh zinc substrate surface, comprising: priming the zinc surface with a non-sticky continuous priming coat, about 0.05-0.2 mil in thickness, of a resilient adherent resinous interpolymer of monomers consisting essentially of about 3-12% by weight of acrylic acid and the remainder of monomeric acrylic acid ester of non-tertiary alkyl alcohol the molecules of which alcohol have from one to fourteen carbon atoms, the average being about 4-10 carbon atoms, at least a major proportion of said molecules having a carbon-to-carbon chain of at least four carbon atoms terminating at the hydroxyl oxygen atom, said chain containing at least about one-half the total number of carbon atoms in the molecule, said interpolymer having an intrinsic viscosity of about 0.7-2.5; and applying over said priming coat a protective and decorative coating of oil base paint.

Automatic Plating Machine

U. S. Patent 2,958,639. *Nov.* 1, 1960. *G. J. M. Laneyrie.*

An automatic installation for advancing workpieces through a succession of work stations.

Printed Circuits

U. S. Patent 2,958,928. *Nov.* 8, 1960. *L. A. Bain, Jr. and R. A. Geshner, assignors to Western Electric Co., Inc.*

The method of making printed wiring boards, which comprises fixing photo-resist on a metal foil bonded to an insulating board in a pattern leaving a row of terminal portions of the foil not covered by photo-resist, fixing a masking tape to the covered foil in a position covering only the row of terminal portions, applying asphalt varnish to the portion of the photo-resist not covered by the tape, removing the tape, immersing the board in a gold-electroplating solution, electroplating gold on the terminal portions, removing the board from the solution, removing the asphalt varnish and the photo-resist, photo-printing a wiring pattern including the terminal portions on the foil in photo-resist, fixing the photo-resist on the foil, etching away the portions of the foil not covered by the photo-resist, and removing the photo-resist from the foil.

Vacuum Coating

U. S. Patent 2,959,494. *Nov.* 8, 1960. *G. A. Shepard, assignor to Republic Steel Corp.*

The method of preparing a ferrous metal surface for vapor deposition of an aluminum coating which comprises treating the surface with an acid solution to remove impurities, passivating the acid cleaned surface with an alkaline solution to produce an elemental surface, wiping the elemental surface and squeezing and blowing the surface to dryness without oxidation for the deposition thereon of a coating of aluminum from a vapor of aluminum in a vacuum.

Paint Mask

U. S. Patent 2,959,152. *Nov.* 8, 1960. *R. K. Byers and R. Shaffer, Jr.*

A device for masking a given three-dimensional raised symbol member mounted on a surface area during painting upon said area; said device being a thin, flexible, paint-impermeable sheet-like element having inner and outer surfaces which are substantially parallel, said element having a shape which conforms to the outer surface of said symbol member and being formed of shape-retaining plastic material, said inner surface being recessed and carying thereon a contact-adhesive material for adhering said element to the outer surface of said symbol member.

Electrostatic Spraying

U. S. Patent 2,959,353. *Nov.* 8, 1960. *F. A. Croskey and C. D. Tuttle, assignors to General Motors Corp.*

An electrostatic coating installation for spraying an article to be coated and including an electrically grounded spray gun projecting particles of coating material for deposition on said article.

Portable Pneumatic Spray-Painting Unit

U. S. Patent 2,959,358. *Nov.* 8, 1960. *W. D. Vork.*

Liquid spraying apparatus for spraying liquids and for dispersing the sprayed liquid with compressed air and for drawing the liquid from a container in which it is substantially at atmospheric pressure.

Spray Coating Machine

U. S. Patent 2,960,065. *Nov.* 15, 1960. *R. B. Way and C. D. Hersey.*

A painting machine comprising a frame, a vertically disposed wall on said frame, means supporting paint guns on said frame on one side of said wall, two spaced parallel, relatively narrow slots in said frame, nozzles on the side of said wall remote from said guns and disposed a substantial distance from said guns, tubes extending through said slots and connecting said nozzles to said guns, means on said machine adjacent said nozzles for supporting an article to be painted, and means on said machine to move said nozzles relative to said supporting means for said article.

Printed Circuits

U. S. Patent 2,959,525. *Nov.* 8, 1960. *P. E. Ritt, Jr. and J. R. Sayers, Jr., assignors to Melpar, Inc.*

A method of electroplating a print-

ed circuit upon a copper clad plastic base, comprising the steps of: masking the entire base with a photographic resist; masking selected portions of the base by selective exposure of the photographic resist to light through a transparency pattern; dissolving the unexposed portions with photographic resist developer; developing the unexposed photographic resist; resulting in the formation of photographic images on the copper layer; the images including a printed circuit pattern and a divisional line separating the base into a major circuit area and a minor border area; the photographic images outlining conductors and connector bars on the major circuit area; the connector bars electrically joining the conductors with the border area; plating a layer of solder on the outlined conductors and connector bars and the border area; removing the resist; then subjecting the non-solder plated portions of the major circuit area to a chemical action to remove the excess copper therefrom; remasking the entire base with the exception of the connector bars and the border area, by painting with a photographic resist; subjecting the photographic resist portions to a period of drying; anodically deplating the solder from both the unmasked connector bars and border area; applying a thin layer of nickel on both the connector bars and border area; then applying a thin layer of rhodium over both the nickel plated connector bars and border area; removing the masking from the base; both the nickel and rhodium plated border area and connector bars jointly forming an electrical conductive electrode for the solder plated conductors.

Deposition of Rare Metals

U. S. Patent 2,959,532. *Nov.* 8, 1960. *C. F. Hendee, W. B. Brown and S. Fine, assignors to North American Philips Co., Inc.*

Apparatus for depositing a thin layer of a metal on an electrically conductive material base comprising an anode having a surface covered with an inert absorbent material adapted to be wetted with a solution of said metal, a cathode having a surface constituted by said electrically conductive material opposed to and of the same shape as said absorbent material covered surface, two fixed spaced guide posts positioned to guide the cathode into contact with the absorbent material, means for moving said cathode into contact with said inert absorbent material, means for passing a current between said anode and said cathode of sufficient density and for sufficient time to effect electrodeposition of said metal on said cathode surface, spray means adjacent to said anode and cathode for applying a wash liquid to said cathode and said anode while maintaining said current after a sufficient thickness of said metal has been deposited on said cathode and exit means for removing said wash liquid from said anode and cathode.

Buffing Wheel Control

U. S. Patent 2,959,899. *Nov.* 15, 1960. *E. F. Eger, assignor to Western Electric Co., Inc.*

A control system for a buffing apparatus having a buffing wheel moved in accordance with buffing pressure and a cyclically-operated buffing compound applicator gun for spraying the buffing wheel which comprises a motor having a control circuit, means operated by the motor for cyclically operating said applicator gun, a bank of selectively connected rheostats in said control circuit, and means operated by the advancing buffing wheel for selectively connecting said rheostats in said control circuit.

Anode Shifting Device

U. S. Patent 2,960,456. *Nov.* 18, 1960. *J. V. Davis, assignor to The Udylite Corp.*

Anode shifting device for a plurality of anode bars arranged in a generally rectangularly shaped anode nest, said device comprising means mounting said bars for reciprocating inward and outward movement with respect to said nest, and actuating means attached to said mounting means for causing said reciprocation.

Vacuum Metalizing

U. S. Patent 2,960,457. *Nov.* 18, 1960. *O. F. Kuhlman, assignor to Servomechanisms, Inc.*

Apparatus for coating materials in a vacuum.

Hot Paint Coating Strip

U. S. Patent 2,961,336. *Nov.* 22, 1960. *A. E. Uhleen, assignor to National Steel Corp.*

A method of coating metal strip with paint comprising the steps of passing heated metal strip along a predetermined path, applying a coating of heated paint onto a surface area of the heated metal strip as it is being passed along the path, the paint being at a temperature approaching the flash point and the metal strip being at a temperature at least about that of the heated paint, and then leveling and metering the applied coating by urging the coating counter to the direction of travel of the strip while also urging the coating laterally to thereby obtain a uniform coating of paint.

FOREIGN LITERATURE

Colored Zinc Coatings

H. W. Dettner: *Metalloberflaeche*, **14**, No. 8, 245.

Of the coatings achieved by chromating, the colorless is often preferred as, with this, a color resembling chromium can be obtained. To a smaller extent, thicker chromate coatings are applied which can show a yellowish iridescent or an olive-green color in addition to blue and green shades.

Oxide-chromate coatings are also obtained electrolytically by the action of the chromating solution, primarily consisting of a gel of precipitated trivalent chromium compound. Little is known regarding the precise composition of this film. Broadly, in addition to about 28% of trivalent chromium compound present, there is present about 8% of hexavalent chromium. This latter is water-soluble and, accordingly, is gradually leached out of the chromate coating in use. This hexavalent chromium has a favorable effect on the corrosion-protective behavior of the coating. This is because, particularly in a moist atmosphere, at any uncovered places, cracks, pores, etc., a self-healing of the coating is thus induced.

The chromate coating is porous. It can absorb and retain organic dyestuffs in a similar manner to anodized aluminum. Processing is conducted, of course, so as to produce colorless, bright chromate coatings.

A particularly valuable feature of this new coloring technique is that the greatly desired gold tones can now be obtained on zinc, as in the case of

anodized aluminum. Apart from the application of this process for coloring massive zinc or zinc-plated parts, a further recent development has been the adaption of the process for the treatment of hot-dip galvanized parts.

Zinc die-castings and components which have been zinc-coated by hot-dip galvanizing can only be chromated, usually, after previous activation (removal of the oxide skin) with special activation preparations, weak acids (for example, cold 2% sulfuric acid) if no degreasing is necessary. Or else, alkali solutions (for example, 25 g./l. trisodium phosphate at 77°C.). If a good color is not obtained by employing these means, then the only method left is to apply a thin electroplated zinc coating which is then processed in the normal way.

Not every chromating solution is suitable for the production of a coating suitable for coloring. The dimensions of the part are not changed to any practical extent by chromating as the zinc coating is only affected to the extent of about 1-2 microns.

After chromating, the ware must be protected carefully against mechanical damage, as the wet film is sensitive to scratching. It is best first to rinse the parts twice and then subsequently to treat for about 1 minute at room temperature with the dye solution. The dye bath is prepared by dissolving about 1 g./l. of the organic dyestuff in pure water. Tapwater is not always suitable. The dyestuff is first dissolved in a little hot water and this solution is then poured into the coloring bath. After coloring, the ware is again carefully given a cold rinse and then dried in a current of warm air (small parts in a centrifuge). Too-rapid a drying is to be avoided as this can lead to dehydration of the film. The total content of the chrome-chromate structure can be lost in this way, so that a noticeable reduction in the corrosion-protection can be noticed. Dehydration occurs at temperatures above 65°C.

Electropolishing Carbon Steels

Metalloberflaeche, **14,** No. 8, 256.

The most commonly used baths for electropolishing the carbon steels are those containing phosphoric - sulfuric acid and perchloric-acetic acid. As compared to stainless steels, electropolishing of carbon steels for decorative purposes is a comparatively recent development. The problem is the non-homogeneous structure of the material. It is somewhat difficult to obtain a satisfactory standardized treatment.

The solutions used for electropolishing carbon steel are similar to those used for stainless steels. Experience has shown that satisfactory results are obtained from a bath of the following composition:

Phosphoric acid (d.=1.70)	65-70%
Sulfuric acid (d.=1.84)	12-15%
Chromic acid (optional)	5- 6%
Water	Balance

A bath of this type is operated at a temperature of 65-75°C. and at 35-50 amp./dm^2, with a treatment time of 10-15 minutes. Bath maintenance consists of adding sulfuric and phosphoric acids according to the requirements indicated by analysis; water, however, must also be added periodically so as to cover the evaporation losses. It is normally sufficient to add water on the basis of the specific gravity of the solution; the s.g. increases with the concentration-rise in the metal content of the solution. After every addition of water, it is good practice to heat the solution for 1-2 hours at 90°-100°C. before the bath is again placed into production service.

It is normal practice in Russia to immerse electropolished carbon steels for 10-14 minutes in a sodium hydroxide solution (100 g./l.) at 60-80°C. This improves the continuity of the passive oxide film which covers the metal and increases the resistance to corrosion and discoloration.

If the steel is to be electroplated after the electropolishing treatment, this alkaline treatment need not be applied. In this case, the oxide film present on the steel surface can be removed by a short immersion in 5% sulfuric acid.

Electropolishing of carbon steels is being praticed in Russia on a very large and ever-extending scale. Automatic and semi-automatic layouts are adopted as normal practice for the machines.

Throwing Power in Metal Plating and Leveling

E. Raub: *Galvano* (Paris), **28,** No. 275, 572.

Different methods have been developed to determine the macrodispersion of plating baths (throwing power); these methods are often adapted to special service conditions. They permit determining the differences in the throwing power of plating baths under the conditions chosen, but they give no information on the distribution of the metal deposit on any object. Most often, such tests do not serve for the determination of the dispersing power of the bath but, rather, of the covering power and of general control of these.

It has been confirmed that polarization concentration in the electrodeposition of alloys is of particular importance for the macro- and micro-dispersion of plating baths. For a low polarization concentration such as rules, generally, in acid baths, the macro-dispersion power is most often poor, while, on the contrary, the micro-dispersion is good. The electrolytes in which the deposition of metals is effected with a high polarization concentration, such as the cyanide baths, have a good macro-dispersion. But, as soon as strong local differences are produced in the thickness of the cathode diffusion coating, either by the shape of the objects or by the influence of the macroprofile or microprofile, the dispersion power becomes bad.

Leveling, i.e. a greater growth of the coating thicknesses in the hollows than on the high-parts of the micro-rough surface by the concentration of the current lines of force in the hollows, cannot be produced in baths having a low concentration of ions capable of discharge. Plating baths having a high polarization concentration (the majority of the cyanide baths), accordingly, have no leveling power. On the contrary, suitable additions to baths with a high concentration of ions capable of discharge (acid baths), can exercise a leveling action. This can be explained by the fact that these leveling addition agents are absorbed by preference at the ridges and points of the microprofile of the cathode. The current lines of force thus, are diverted towards the hollows and, at these places, thicker deposits are produced. Apparent leveling, however, is most dangerous. It can be obtained by an oriented crystalline growth in the sense of the current lines of force, on the lateral surfaces of the hollows. This produces covered hollow spaces, or "masked pores," which are most undesirable. They are filled with bath liquid and can give rise to more intense corrosion.

RECENT DEVELOPMENTS

NEW
METHODS, MATERIALS AND EQUIPMENT FOR METAL FINISHING INDUSTRIES

Viscose Filter Tubes

Sethco Mfg. Corp., Dept. MF, 2284 Babylon Tpke., Merrick, N. Y.

To meet the demand for low-cost replacement type filter elements, an economy line of viscose filter tubes is now available for use with the above manufacturer's filters. They are priced to reflect savings of 20% over the cost of cotton tubes.

Viscose is suitable for mildly acid and alkaline solutions in the pH range of 3 to 11. They are available with either perforated steel, stainless steel, or perforated polypropylene cores in #5 and #10 sizes. Standard densities available in viscose are medium, fine, and x-fine. These densities are equivalent to filtration down to 25, 15, and 10 microns respectively.

Photo-Resist Stripper

Enthone, Inc., Dept. MF, 442 Elm St., New Haven 8, Conn.

A non-flammable liquid which rapidly removes Kodak Photo Resist (KPR) and other acid resists from printed circuit boards after etching, Stripper "K" removes most photo resists in less than one minute. Pressure spray rinsing is usually all that is required to remove residual resist after immersion in the stripper, thus eliminating laborious scrubbing of the boards.

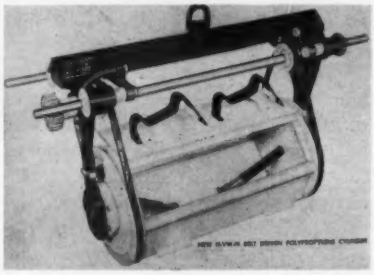
The stripper is used full strength at room temperature. After etching away of exposed copper, printed circuit boards are simply immersed in the stripper until the photo resist is wrinkled or softened sufficiently so that it can be flushed away in a subsequent cold water rinse. There is no attack of most printed circuit boards. The stripper may be contained in plain steel tanks or drums. It does not contain phenol or phenolic compounds.

Plating Barrel

Hanson-Van Winkle-Munning Co., Dept. MF, Church St., Matawan, N. J.

The above manufacturer has announced the successful completion of two new plating barrel improvements. The first is the introduction of a new barrel material, polypropylene. The second improvement is a new type hanger for belt-driven cylinders that allows the operator to replace worn belts by merely snapping the old belt off its pulley and snapping a new one in its place.

The new type hanger leaves the belt pulleys totally exposed and easily accessible. The new pulley arrangement,



however, does not impair the standard feature of all the firm's barrels, that of keeping all bearings free from contact with hot corrosive solutions.

The Mercil-type polypropylene barrel is one-piece molded, ribless and has all heat welded joints reinforced with stainless steel screws. Panels are ½" and perforated to suit customers specifications. Inside surfaces are convex to add strength and facilitate tumbling. Polypropylene can withstand plating, cleaning, or acid dipping at temperatures up to 200°F.

Fume-Controlled Chromium Plating Compounds

Metal & Thermit Corp., Dept. MF, Rahway, N. J.

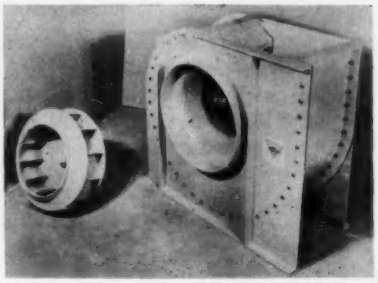
New fume-controlled compounds are stated to offer the plating engineer the opportunity of reducing costs and simultaneously minimizing the objectionable effects of fumes from chromium plating solutions. Plants that already use Unichrome SRHS compounds CR-100, CR-110, CR-120 or CF-520 can convert their present solutions to automatic fume-controlled versions in a few minutes and at minimum cost. Other solutions, too, can be converted quickly and easily.

Supplied in pelletized form, the new compounds provide in a single product the necessary chromic acid, a plating "catalyst," and a chemical fume suppressor that acts as a built-in ventilation aid. Under most operating conditions, fume suppression is maintained automatically and special additions are not necessary. However, where tank ventilation is poor or where there is excessive drag-out by foaming, occasional addition of Fumetrol may be required to supplement the fume suppressor in the compound.

Reinforced Plastic Blower Housing and Fans

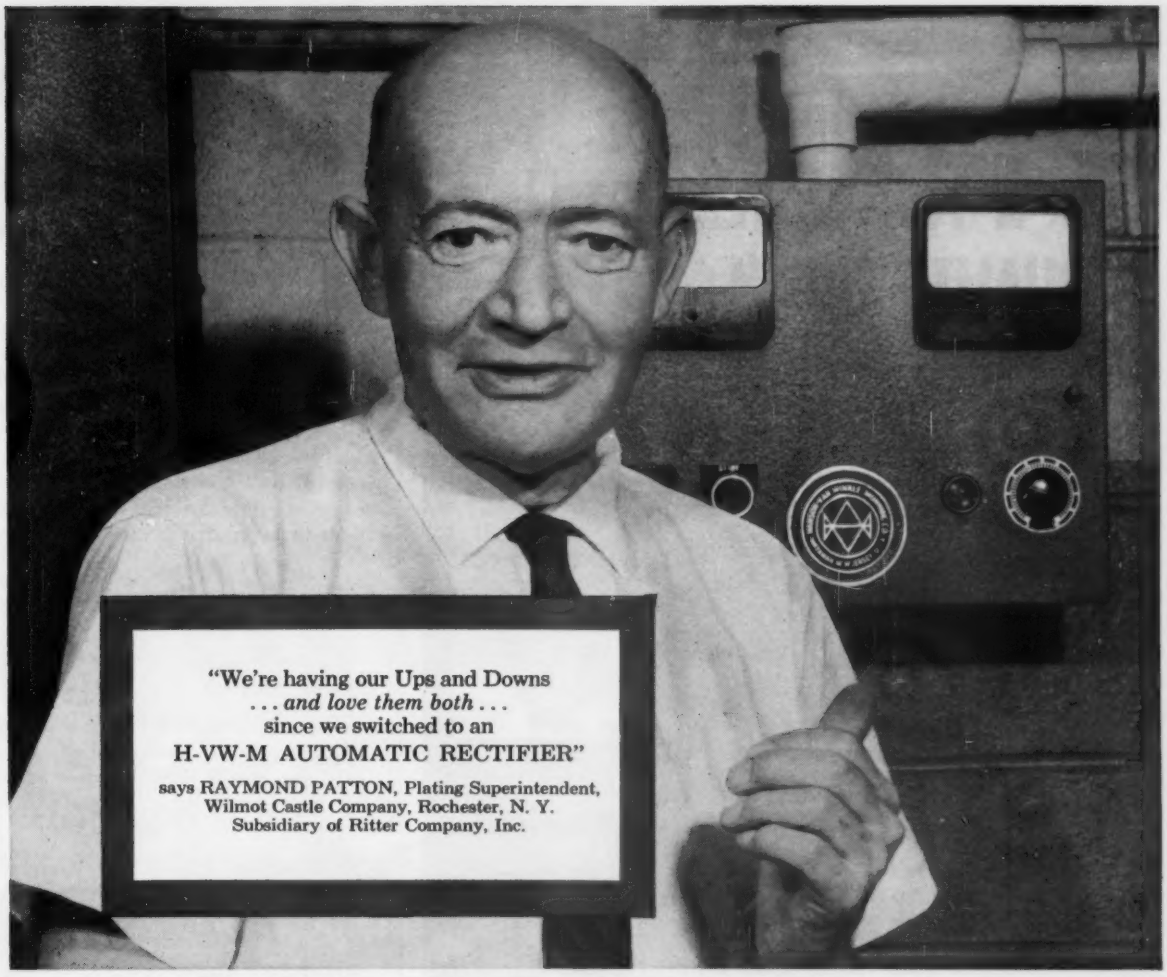
Ceilcote Co., Dept. MF, 4832 Ridge Road, Cleveland 9, Ohio.

A new line of Duracor reinforced plastic centrifugal blower housings with Duracor-covered standard fan wheels offers extreme chemical resistance plus high strength/weight ratios. The new units can be installed as sepa-



rate components in existing systems or integrally designed into entire exhaust systems.

Both housings and ducts are corrosion-proof throughout to provide maximum resistance to attack from practically any acid, alkali or fume.



UP 5% goes production...
DOWN 25-30% go dial manipulations

Requirements for current vary widely in the chrome-plating operations of Wilmot Castle Company, one of the largest makers of sterilizers, lamps, and other hospital, dental, surgical equipment.

Added to the normal trickiness of chrome is the fact that the company plates some 300 different parts—ranging from a few ounces to 50 lbs. in weight. With the manual tap-switch rectifiers used before, a lot of time was spent in twiddling dials to meet correspondingly large swings in current needs.

But now... with the new Automatic Rectifier from H-VW-M... dial setting remains the same. Current is adjusted automatically for changes in load. With human error removed, rejects are down 5%. Plate is more uniform—for while the old method provided 44 steps of control, with Automatic Voltage Stabilization, control is stepless, virtually infinite.

Says Ray Patton, Wilmot Castle's plating superintendent: "We're gradually retiring all our rectifiers of the tap-switch type—and putting in H-VW-M units that practically think for themselves. We've found that what they seem to think about the most is ways to up our production, cut our costs down."

If that kind of thinking appeals to you—whether you're doing chrome-plating or any other kind—phone or write H-VW-M for details on the most complete line of plating rectifiers featuring Automatic Voltage Stabilization.

H-VW-M *Progress in metalfinishing through advanced processes • equipment*

Hanson-Van Winkle-Munning Company, Matawan, New Jersey • Offices in Principal Cities
Alert Supply Company is H-VW-M in the West • Los Angeles • San Francisco

Wetting Agent for Zinc Baths

Conversion Chemical Corp., Dept. MF, Rockville, Conn.

A new liquid wetting agent, Kenvert No. 15-WA for use with cyanide zinc plating solutions, was originally developed to emulsify grease dragged into plating baths from insufficient metal preparation in the cleaning cycle. It was also designed to unplug the holes in plating barrels caused by break-down of brighteners in the plating solution.

In addition to these important factors it was found that better drainage of the zinc solution developed through lowered surface tension, and that the light foam blanket that developed on the solution stopped fuming, and decreased to a considerable extent the build-up of salts on anode bars.

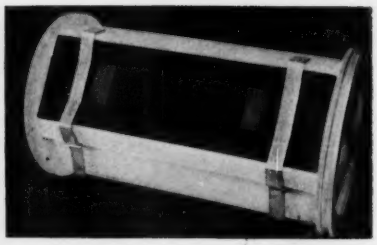
Another very important advantage claimed for the product is that it produces grain refinement and limited brightening.

The material is compatible with practically all brighteners on the market, it is stated.

Plating Barrels

Imperial Industries, Inc., Dept. MF, 3600 Earl St., Wayne, Mich.

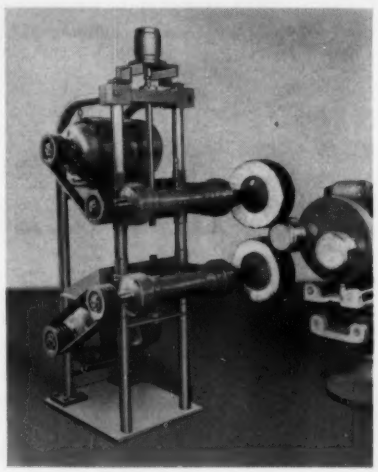
New horizontal plating barrels of polypropylene are equipped with Cycolac doors secured by stainless steel clamps. Models are available for either gear drive or belt drive. The use of polypropylene results in many advantages. It is light weight (specific gravity 0.90) yet has greater strength and abrasion resistance. It has excellent resistance to heat and chemicals. Virtually indestructible, it stands up under all temperatures and solutions normally encountered in the plating process. The barrels feature sturdy, all-welded construction, and are made in a wide range of standard sizes and perforations to fit existing plating equipment.



Dual Spindle Metal Polishing Lathe

Murray-Way Corp., Dept. MF, Box 180, Birmingham, Mich.

This economical lathe, the Model L12, cuts fixture costs in half, since only one Han-D-Matic or other semi-automatic part-positioning machine is required to do the job formerly requiring two machines. Time-consuming transfers to a second fixture are eliminated, and less floor space is required.



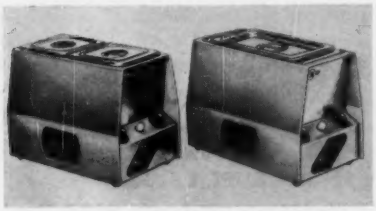
Designed with a minimum of frills and extras, the lathe employs two separate top quality, motor-driven spindle assemblies, mounted on one simple, sturdy base. When both wheels are utilized for the same operation, production is doubled. If one wheel is used for cut-down, the other for color-

ing, the result is a finished job with only one fixturing of the part.

Each alloy steel spindle is adjustable to compensate for wheel wear, and work wheel speeds may be varied by a simple change of motor sheaves. The bearings, placed on wide centers for better work pressure distribution, are permanently lubricated, and are protected from dirt by efficient labyrinth seals. Lock pins hold the spindles stationary for replacement of work wheels. The lathe stands approximately 7′ high and requires only 43″ by 34″ of floor space. Belt guards and cabinet are available if desired.

Ultrasonic Cleaning Units

L&R Mfg. Co., Dept. MF, 577 Elm St., Kearny, N. J.



The Ultra-Cleen '320' Series utilizes a new electronic circuit to channel "peak power" directly from a built-in generator to the transducerized tanks. The units also feature a new electrical timer to control the cleaning cycle; the timer turns off the current after a pre-specified period.

Tank dimensions of the '320D' are 5⅜″ square by 3″ deep at the top with a ½″ taper on each side. Tank dimensions of the '320L' are 5⅜″ by 9⅜″ by 4″ deep at the top with ½″ taper on each side. Power output on the '320' and '320D' is 55 watts; power output on the '320L' is 60 watts. Overall dimensions (14¾″ by 9″ by 10½″), operating frequency (70-80 K.C.), and power consumed (160 watts) are the same for all models in the series.

Abrasive Blast Nozzle

Metal Improvement Co., Dept. MF, 1721 E. 47th St., Los Angeles 58, Cal.

A new, lightweight and long wearing rubber nozzle for wet or vapor

blasting machines is outstanding in ease of handling, requiring no counterbalancing. The gun will outlast much heavier nozzles and will, by its easy manipulation, improve operator performance and production. Parts cannot be damaged if touched by the gun. Metal parts are non-ferrous, and clamps on the lengths of hoses supplied with the gun are stainless steel. This gun fits wet blast machines of most makes and models.

Decorative Coating for Plastics

Sullivan Chemicals Div., Sullivan Varnish Co., Dept. MF, 420 Hart St., Chicago 22, Ill.

CL-6091 Epoxy Metalplex is a synthetic, type metalizing coating that may be used as both a base coat and top coat, and performs equally well on both surfaces, it is claimed.

The product may be sprayed as supplied, or additional solvents added to suit a particular application. It is well suited to flow-coating and dipping operations, and has the ability to release solvents rapidly; therefore, dust accumulation on sprayed work is at a minimum, it is claimed. After base coating, a flash-off time of 15 minutes is required.

The coating contains no phenolics, which accounts for its pale color and resistance to after-yellowing and darkening upon aging. Finished ware will retain its original sharp clarity and

brilliance for years, according to the manufacturer.

Primer for Organosols and Plastisols

John L. Armitage & Co., Dept. MF, 245 Thomas St., Newark 5, N. J.

P-289 Primer has been developed specifically for use with plastisols, organosols and the company's Armorhide textured vinyl finishes. The new primer exhibits excellent color retention and resistance to salt spray and humidity. Its adhesion to substrates, such as steel, aluminum, galvanized metal, and glass, is outstanding, it is claimed. The primer may be applied by spray or dip coating and can be air-flashed or baked. Drying time when air-flashed is about 5 to 15 minutes; when baked, from 5 to 10 minutes. Clear or pigmented samples are available for a laboratory testing.

Immersion Tin Process

Shipley Co., Inc., Dept. MF, Walnut St., Wellesley 81, Mass.

A new chemical process for depositing a protective tin coating on metal surfaces, Cuposit LT-26 is claimed to produce a stable solution, and coating is instantly accomplished by quick dipping.

A pure tin coating is obtained with good bond and sufficient depth to provide good fusion to the basis material. Since no tin is deposited on non-conductive surfaces, the dielectric properties of printed circuit boards are unchanged.

Pickling Inhibitor

Atlas Powder Co., Dept. MF, Wilmington 99, Delaware.

A new hydrochloric acid inhibitor, Atcor HC, developed for use in pickling and acid cleaning applications is an isopropanol solution of a complex, high molecular weight amine blend which forms an organic film on metallic surfaces and prevents the hydrochloric acid from reacting.

Coated Abrasive Bands

Behr-Manning Co., Dept. MF, Troy, N. Y.

New coated abrasive bands and belts, which assume any desired degree of crown when run on inflatable rubber drums, are suited for both stock removal and polishing, and are recom-

mended for offhand work in confined areas, particularly on concave or other contoured surfaces. Their crowned shape eliminates the edge cutting that occurs when a flat band is inadvertently tilted, permits accurate grinding on extremely narrow areas, and diminishes chattering at low pressures.

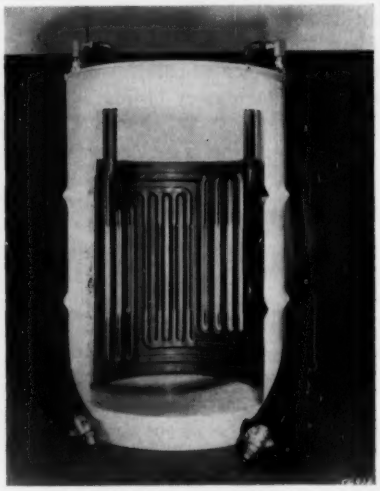
They are made of aluminum oxide abrasive in grits 40 through 180 on X-weight cloth, bonded with all-resin adhesives. Bias-cut but not molded, the new bands assume a crowned shape when the pneumatic wheel or drum is inflated. Once the crown has been generated, pressure may be reduced to match requirements. "Kontoor" bands are available in three sizes: 2 x 9⅝, with maximum speed of 6,000 r.p.m.; 2½ x 15½, with 4,500 r.p.m. maximum; and 2 x 19 inches, not to exceed 4,000 r.p.m.

These bands will not take an exact shape; instead, their degree of crown will depend on grit size, air pressure in the drum, the drum speed and the pressure exerted on the work. A more severe contour can be developed by wetting the backing of the bands before mounting them. This lets them stretch a bit further; their rotation soon dries them out.

Immersion Drum Warmer

Platecoil Div., Tranter Mfg., Inc., Dept. MF, 735 E. Hazel St., Lansing 9, Mich.

An immersion-type drum warmer, designed for standard 55-gallon drums, consists of a Platecoil heat transfer unit, rolled to the proper diameter to



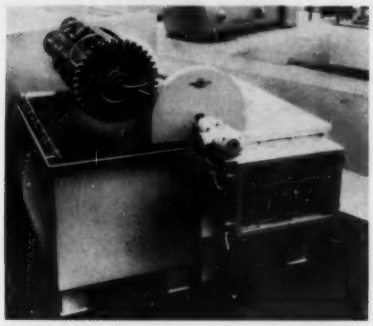
fit the contour of the drum wall. It is available in either serpentine or header construction, with inlet and outlet connections outside of the drum.

Although the unit will be available in six different sizes, the 22″ x 29″ mild steel size only will be carried as a stock item, with the others available for 3 to 4 week delivery.

Plating Barrel

N. V. Nederlands Chemisch Technisch Bedrijf v/h ELPEWE, Dept. MF, Uithoorn, Holland.

An automatic swinging barrel apparatus for plating baths is equipped with special automatic timer to control the immersion time. The unit consists of two tanks, arranged one behind the other, with a rotating drum above. On top of the vertical partition between the tanks is the main shaft around which the drum rotates from tank to tank. The forward or sheet metal tank contains the rinsing water, and the rear



tank, which holds the plating solution, is lined with wire glass to suppress the generation of stray currents in the alkaline bath. When acid baths are used, a hard rubber lining is fitted to this tank.

The pentagonal-shaped swinging barrel is made of specially treated plastic and designed with corrugated sides and slotted perforations to enlarge the active surface, considerably increasing productive capacity. The vaulted shape facilitates liquid exchange and serves as a preventive against flat objects adhering to the sides.

The drum is powered by a motor with a gear-wheel transmission; the turning device by a motor with a worm-gear transmission. The fully automatic process control is housed in a switch box mounted beside the rinsing bath. When the automatic timer shuts off the plating operation, the pointer returns to the pre-set time and the process is ready to be repeated on a new batch.

Electrostatic Spray Painting

Ransburg Electro-Coating Corp., Dept. MF, Box 23122, Indianapolis 23, Ind.

The latest development for automation of production painting lines features No. 2 electro-spray process bell atomizers, a unit which automatically paints articles of different sizes, according to the above manufacturer.

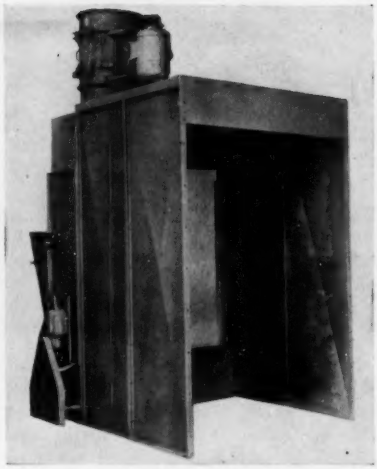
Wide flexibility makes this set-up adaptable to many finishing requirements, it is claimed. As the size of the articles to be painted changes, automatic sensing devices reposition the bells in and out to maintain correct painting distance. Paint is triggered on and off automatically by a metering valve to accommodate variations in length and spacing of articles on the line. Likewise, changes in height of work patterns are handled by turning the bells on and off selectively. Reciprocal motion of the bells produces an especially uniform, electrostatically-deposited paint coating.

Rust Preventive

E. F. Houghton & Co., Dept. MF, 303 W. Lehigh Ave., Philadelphia 33, Pa.

Rust Veto 342 is especially designed for metal surfaces stored outdoors for long periods where a transparent film is useful so painted or stamped numbers are visible. This product also protects from salt spray in overseas shipment.

The material is easy to apply and remove. The plastic film is not brittle and will not chip. It will not crack or flow from -40°F. to 175°F. It contains



used up, it is discarded and a new 150-yard roll is installed in its place. This design eliminates the need for pumps, piping, water, water treatment, sewer connections, and booth and stack cleaning.

The booths are built to meet specifications of the National Fire Protection Association Code 33 and have been approved by all major insurance companies and fire marshals. Conventional spray booths can be easily converted.

Conversion Coating for Aluminum

Frederick Gumm Chem. Co., Inc., Dept. MF, 538 Forest St., Kearny, N. J.

Aluminum treated in the Alcorite IV process will withstand 250 hours of salt spray with little or no corrosion, it is claimed. In addition to its protective coating, the product provides optimum paint adhesion, and paint coatings which will resist 500 hours of salt spray treatment.

This simple low cost process can be applied by dip or spray and has been approved by the U. S. Navy for compliance with Specification MIL-C-5541 as applicable.

Paint Stripper

Chemclean Prod. Corp., Dept. MF, 15-08 121 St., College Point 56, N. Y.

#441B has been developed to strip zinc-clad steels of paint without attacking the zinc, and provides economy of operation, long tank life, and simple control. A mixture of strongly alkaline salts, used at 8 to 16 oz./gal. of water at 180° to 200°F. in a mild steel tank, the material is claimed to strip quickly and completely, leaving a surface

solvent for ease of application, and can be removed with solvent or a mild alkaline cleaner.

Cadmium Conversion Coating

Hanson - Van Winkle - Munning Co., Dept. MF, Church St., Matawan, N. J.

Chem-Rite C-55 is an inexpensive single dip chromate conversion coating process for cadmium, which enhances the brightness of the deposit, produces a clear chromate surface and is extremely easy to operate. No subsequent leaching is necessary.

The material can be used with any bright cadmium process, but it is especially effective when used in conjunction with the firm's bright cadmium, Cadalume L, it is claimed.

Automatic Dry Spray Booth

Binks Mfg. Co., Dept. MF, 3114 Carroll Ave., Chicago 12, Ill.

The "Dispo" automatic dry spray booth collects paint overspray on a disposable cloth curtain mounted in the booth where filters are normally installed. The cloth is mounted on rollers so that it can be rotated when the exposed area is saturated with paint particles.

The booth is designed to exhaust approximately 300 c.f.m. of air per square foot of cloth area at a maximum of 3" resistance pressure. As resistance pressure builds up, a pressure differential switch operates a motor drive to advance a new section of clean media. When the cloth is fully

ready for immediate re-painting without further treatment. It will remove alkyds, melamines, phenolics, urea, urea formaldehyde resins, and other synthetic paints.

One-Coat Organosol Coating

Bradley & Vrooman Co., Dept. MF, 2629 S. Dearborn St., Chicago 16, Ill.

A unique series of organosol coatings, Sterilkote 360, that give outstanding metal adhesion with only one application and no primer, are claimed to be much more abrasion resistant than those conventional coatings requiring two applications and priming.

The organosols are vinyl resin based and may be applied by manual, automatic, or electrostatic spray equipment, as well as by regular and reverse roll-coaters. The baking cycles are flexible and can be varied to suit different production ovens.

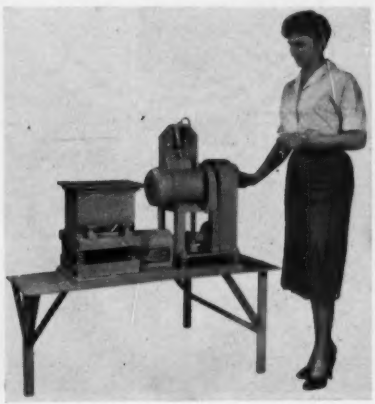
The new organosols, besides being highly protective, are highly decorative. They can be supplied in a wide color spectrum and can result in either very smooth finishes or textured finishes when applied over embossed metal surfaces. Because of their flexibility and high resistance to humidity, water, salt spray, peeling, chipping, flaking and marring, these organosols have an extremely wide application range.

Vibratory Finisher

Lord Chemical Corp., Dept. MF, 2068 S. Queen St., York, Pa.

This new machine, designated Model 610, has a ¼ cubic foot capacity, with a bowl measuring 6 inches wide, 10 inches long and 8 inches deep. Overall dimensions of the machine are 12 inches wide, 34 inches long and 28 inches high.

Designed for finishing of small and delicate parts, the machine has a load capacity of approximately 35 lbs. of parts and media. The bowl, which weighs about 30 lbs., is removable, simply clamping onto the bed of the vibrator and resting on four coil springs.



It is powered by a ¾ hp motor which drives a variable amplitude shaft by means of a variable pitch pulley. Speed is variable from 700 to 3,500 vpm. Variable amplitude is accomplished by changing the position of counterweights on the shaft.

Accelerated Corrosion Test

Eastern Scientific Co., Dept. MF, 267 Plain St., Providence 5, R. I.

Rustex, a superior corrosion test for steel, can perform in as little as 5 minutes what salt spray tests require days for, it is claimed. This new product is supplied as two separate solutions which, when mixed, provide a readily reproducible corrosion test. Protective coatings can be evaluated by simply immersing both test and control panels in a freshly-mixed solution and comparing the results. This method is especially recommended for evaluating pieces treated with chromate conversion coatings, black oxide, plastisols, polyester, vinyl, epoxy and lacquer coatings as well as most electroplated metals.

Samples and further information are available upon request from the manufacturer.

NEW OVERALL FUNCTIONAL DESIGN

Centralized A.C. Control—The new Ultrasil Rectifiers feature a front-mounted, hinged door for fast easy access to all meters, push buttons and A.C. control equipment. This convenient, compact control center is built into the rectifier itself.

Self-locking, Slide-in Panels and Hinged Inspection Doors—Ultrasil's front, side and rear panels are easily removed for inspection and maintenance. Hinged doors, both front and rear, provide a quick means of inspecting the control equipment, fan and heat sink assemblies.

Trim Appearance, Lasting Finish—Clean styling, two-tone color and chrome trim bring the modern look to plating equipment. Rust-resistant enamel with a bonding primer offers a superior protective coating under all plating conditions.

Uniframe Construction—One-piece welded frame gives increased rectifier ruggedness, reduces overall weight.

Ultrasil Ultrasil Ultrasil Ultrasil Ultrasil Ultrasil

❶ NEW TRANSFORMER DESIGN

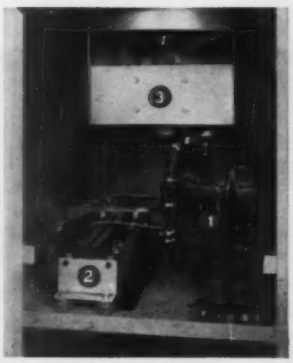
Featuring proven *Balanced Power* design, Ultrasil Transformers eliminate diode matching and balancing reactors. Top quality silicon transformer steel, improved varnish coating, silver soldered electrical connections with the elimination of mechanical connections are but a few of the many new features. Transformers are conservatively rated, have Class B insulation and are designed for optimum ventilation.

❷ NEW DIODE ASSEMBLY DESIGN

New, one-piece, solid copper finned heat sink assembly provides peak cooling efficiency, requires less room, is easily accessible. Improved Silicon Diodes have new ceramic insulation. Soldered seals have been eliminated. Flexible connectors feature increased capacity.

❸ NEW VENTILATION SYSTEM

The new fan housing assembly of the Ultrasil coupled with new permanent, built-in baffling assures highest ventilation efficiency.



NEW PROTECTIVE DEVICES

New thermostatic trips give positive protection against diode overheating from any cause. D.C. protective device guards against excessive overload and short circuit conditions. Each diode is protected by a readily accessible fuse.

Ultrasil Rectifiers are available in capacities from 500 to 8,000 amperes, and from 6 to 24 volts; additional capacities, on request. Integral, remote and automatic controls are available. Call your Udylite representative. Or, write:

THE UDYLITE CORPORATION • DETROIT 11, MICHIGAN

udylite

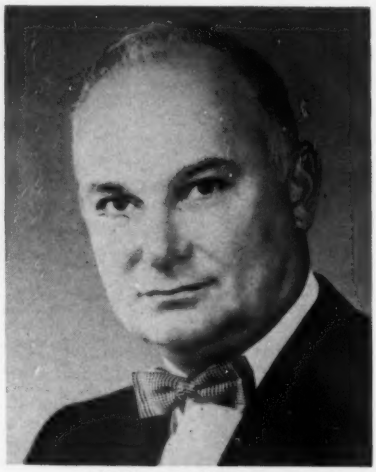
BUSINESS ITEMS

Munkacsy Acquires G. S. Plastics

One of the leading pioneers in corrosion-resistance chemistry, *William A. Munkacsy*, president of *The G. S. Plastics Co.*, has acquired full ownership by purchase of all outstanding shares of that corporation. The acquisition includes all shares owned by The General Supply Co. *T. R. Gill*, formerly an officer, has resigned and is no longer affiliated.

Highlighting its reorganization is a major expansion program for accelerating new developments in corrosion-resistant products for industry — organic coatings, equipment, linings and plastisols.

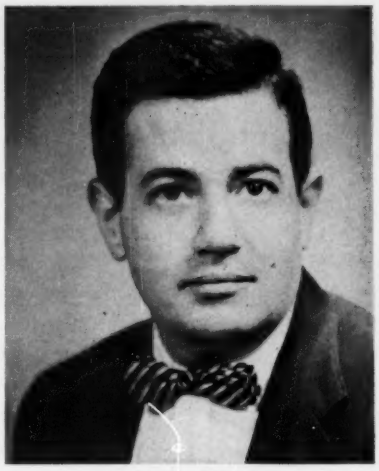
Prior to organizing G. S. Plastics in 1956, Munkacsy was founder and owner of Munray Products and The Poly-Cyclo Products Co., Cleveland.


William A. Munkacsy

Enthone Adds Research Chemist

Ralph N. Kingsbury has joined *Enthone, Inc.* of New Haven, Conn., as a research chemist.

Mr. Kingsbury received a Bachelor of Science degree from Northeastern University and a Master of Arts degree in physical chemistry from Duke University. He was previously senior research chemist for the Sponge Rubber Products Division of B. F. Goodrich Co.


Ralph N. Kingsbury

Industrial Exhibit in England

The first international Industrial Finishes Exhibition of equipment, materials, plants and processes will be held May 8-11, 1961 at Earls Court, London S.W. 5, England. Among the exhibits will be demonstrations of electroplating, galvanizing, metal coloring, vacuum deposition, etc.

Further information may be obtained by writing to *H. J. Conroy*, Scientific Surveys, Ltd., Exhibition Div., 97 Old Brompton Rd., London S.W. 7, Eng.

Westinghouse Appoints Sales Agent

The *Lea Manufacturing Co.* of Waterbury, Conn. has been appointed a sales agent for Connecticut, western Massachusetts and northern New York

for *Westinghouse Electric Corp.* ultrasonic cleaning equipment.

Frederick Gumm Chem. Co., Inc. Names New Sales Rep.

As an additional step in its sales expansion program, *Frederick Gumm Chemical Co.*, 538 Forest St., Kearny, N. J., has named *Marvin R. Moyer* as technical sales representative for its complete line of finishing compounds and equipment in eastern Pennsylvania (excluding Philadelphia), Delaware and Maryland.

Mr. Moyer is a member of the

Marvin R. Moyer

American Electroplaters' Society with a wide background in production and servicing in the metal finishing industry. His office will be maintained in Berwick, Pa.

Detrex Appoints Maloney Research Supervisor

Detrex Chemical Industries, Inc., announces the appointment of *James E. Maloney* to the newly created post of research supervisor, Chemical Processing Division.

Mr. Maloney has been with the company for six years and is a graduate of the University of Detroit, with a B.S. degree in Chemical Engineering.

He has spent his career in the product development of alkali and emulsions, plus one year of technical service in the Chemical Service Department.

H-VW-M Appoints Field

Hanson - Van Winkle - Munning Co. has announced the appointment of *Peder Field* to the position of conveyor sales engineer. In this position, Mr. Field will be responsible for sales-engineering of automatic and related metal finishing processing equipment. He will be based at the company's headquarters at Matawan, N. J.

Peder Field

Mr. Field has been associated with the plating industry since 1950, beginning as plating superintendent for an independent plating company, and later as a plating equipment specialist for a well-known plating equipment supplier.

He is an active member of the A.E.S. (Detroit Branch) and has attended the College of Engineering of the University of Michigan, specializing in Mechanical Engineering.

McGinnis Sales Manager of Singleton Co.

Mark A. McGinnis has been appointed sales manager of the newly organized *Singleton Co.*

Mark A. McGinnis

Mr. McGinnis, a native of Elyria, Ohio, attended the University of Chicago under the Navy Program. He served four years in the U.S.N., 32 months as Lt. S.G. aboard the destroyer Meredith. He was Columbus branch manager of the Colson Corp.; assistant to the president of the Glo-Quartz Electric Heater Co.; assistant sales manager of the Cleveland Process Corp.

Dr. D. S. Carr Rejoins Bart Laboratories

Dr. Dodd S. Carr has rejoined *Bart Laboratories and Design, Inc.*, as vice-president of research, it was announced recently. In addition to his duties in research on new and improved electroplating processes, Dr. Carr will serve as quality control director for the parent company, Bart Mfg. Corp.

Dr. Dodd S. Carr

Until recently, Dr. Carr was technical assistant to the vice-president of the Freeport Nickel Co. and, from 1952 to 1959, was director of research for the Bart Mfg. Corp. For three years prior to that, he was engaged in electroplating research for the International Nickel Co., Inc.

Dr. Carr was graduated from Loyola College of Baltimore in 1945 and received his doctorate in Chemical Engineering from the Johns Hopkins University in 1950. Since then, he has been active in the electroplating industry in research, development, and technical sales. He has published many technical papers and has been granted several electroplating patents. In 1952, he was awarded the Silver Medal of the A.E.S. as co-author of a paper on "Nickel plating with insoluble anodes."

Dr. Carr is a member of the A.C.S., A.E.S., The Electrochemical Society, A.S.T.M., and the Society of the Sigma XI, an honorary research society. He is also listed in the "American Men of Science," and "Chemical Who's Who."

Metal & Thermit Forms Subsidiary in Switzerland

Metal & Thermit Corp. has formed a wholly owned subsidiary in Zug, Switzerland to increase its participation in the growing European market. The new subsidiary, *Metal & Thermit AG*, will act as the parent company's sales and licensing representative in Europe. It will also license its own patents and trademarks.

Dr. Hartmut Richter will be associated with the Swiss subsidiary as technical director. He was formerly European technical representative for the firm. Metal & Thermit AG will be a part of M&T's International Division, headed by *Charles H. Carpenter, Jr.*

Pall Corp. Names Head of Laboratory

Howard E. Abrams has been appointed laboratory manager of *Pall Corp.* He will supervise testing and research services both within the company and for customers.

Mr. Abrams has been with the corporation for over seven years, during which time he has been engaged in

various aspects of laboratory work. Following service with the Army Engineers from 1943 to 1946, he attended the University of Michigan. He is presently a Senior Member of the

Howard E. Abrams

American Chemical Society. In his new position, Mr. Abrams will be responsible for contamination analysis, testing, standardization and cleaning of filter elements, as well as research on and development of a number of new products.

Bacon Directs Midwest Sales for Behr-Manning

Stanley E. Bacon has been named industrial sales manager for the midwestern region by *Behr-Manning Co.* of Troy, N. Y., manufacturer of coated abrasives and pressure-sensitive tapes.

Bacon, whose headquarters will be at the firm's Chicago offices, succeeds *Arthur W. Bell*, regional manager for the past 12 years. Bell asked to be relieved of immediate managerial duties but will continue his headquarters contact work with several large national accounts, working out of the Chicago branch.

Stanley E. Bacon

Bacon has been with the company since 1949, covering both industrial and general trades sales territories in St. Louis, Texas and Arkansas until 1957, when he was advanced to a divisional managership with headquarters in St. Louis.

Frederic B. Stevens Acquires Clark-Cooper

Frederic B. Stevens, Inc., has announced the acquisition of *Clark-Cooper Co., Inc.*, Palmyra, N. J., manufacturer of flow metering pumps and related equipment.

Clark-Cooper's manufacturing facilities have been moved to a plant owned by Stevens in Springfield, Ohio. Sales, distribution, personnel and the headquarters, however, will remain in Palmyra.

Rex A. Taylor, former president of Clark-Cooper, has been elected a vice-president of Frederic B. Stevens, Inc. and will direct the operation of the new Clark-Cooper Division.

Korbelak and Mitwol Named Vice-Presidents for Sel-Rex and Meaker Subsidiary

The appointment of *Al Korbelak* as vice-president, *Sel-Rex Corp.*, and *Sid Mitwol* as vice-president of *The Meaker Co.*, a subsidiary, has been announced recently. According to the announcement, Mr. Korbelak's area of responsibility will continue to be the development of applications and new markets exploration for the firm's diversified line of precious metal electroplating processes as well as liaison with the technical staff in the development of new products for which field work may have uncovered need. Additionally, Korbelak will supervise all customer services.

A graduate of Tufts College, Mr. Korbelak's background includes several years as an electrochemist with Seymour Mfg. Co., where he contributed to the development of their bright nickel processes. He also spent eleven years with Westinghouse Electric Corp. in their Electronic, Chemical and Metallurgical Engineering Departments.

Immediately prior to joining Sel-Rex in 1954, Mr. Korbelak was editor of *Plating* Magazine. The author of

Messrs. Al Korbelak (left) and Sid Mitwol (right) with Morris M. Messing, President of Sel-Rex and Meaker Company.

several papers on the techniques of electroplating difficult metals, he holds patents on pulsating techniques and metal processing.

Mr. Mitwol, who has been general manager, Rectifier Division, for the past year, will continue in this function as vice president and general manager, Electrical Division, The Meaker Co. Having joined the company in 1948 as sales engineer, Mr. Mitwol has progressed through positions of increasing executive responsibility, and was manager of the firm's Detroit office prior to his current assignment.

A graduate Electrical Engineer of C. C. N. Y.'s School of Technology, Mr. Mitwol was formerly associated with Federal Telephone and Radio Co. and Radio Receptor Co., Inc.

Northwest Chemical Appoints Brown and Peabody

Northwest Chemical Co. announces the appointments of *John V. Brown* to serve their accounts in the northwest Ohio area, and *John M. Peabody* in the Youngstown & Pittsburgh areas.

Mr. Brown holds a degree in chemical engineering, and has had ten years of experience in serving chemical needs of various industries. He will work from his home office at Angola, Ind.

Mr. Peabody has been given special training in the application of the firm's products, both in plating and organic finishing. His broad industrial experience and chemical engineering training equips him to work on the line with production men. He will work out of the home office at 9310 Roselawn Ave., Detroit, Mich.

E. F. Lewis Joins Chemical Products Corp.

Chemical Products Corp. of East Providence, R. I., has announced the appointment of *Edwin F. Lewis* to its Chem-o-sol sales division, in charge of sales correspondence and promotion for the company's special formulation of vinyl plastisols. Recently released from active duty with the U. S. Navy with the rank of Lieutenant (j.g.), Mr. Lewis is a graduate of Brown University, where he majored in economics and did minor studies in engineering.

New Top-Management Team Announced by Wilson Rubber

A new top-management team has been installed at the *Wilson Rubber Co.* of Canton, Ohio, makers of rubber gloves.

President *John W. Simmons* moves to Rutherford, N. J., to become executive vice-president and chief of operations of Becton, Dickinson and Co., the parent company.

Stepping into the top operating spot at Wilson is *John Yacos, Jr.*, former plant manager, who has been named general manager. *T. L. Peterson* becomes sales manager, responsible for all sales. He was formerly manager of sales for the Industrial Division.

In other promotions, *George Lenhart* was named factory superintendent in charge of all production, *Elwyn H. Becker* was appointed product development manager, *Howard Olsen* became controller, and *William S. Zimmerman* moved up to plant manager. *Richard L. Moody*, former sales representative in the field, has moved to Canton as assistant sales manager, Industrial Division. *L. E. Novy* has joined the technical staff as plant chemist. He was formerly associated with the Battelle Memorial Institute of Columbus, Ohio.

Division Sales Mgr. Appointed by Houghton

Announcement of the retirement of *Harry Martin*, sales manager of the Detroit Division since 1934, and the appointment of *James H. Richards* as his successor has been made by *E. F. Houghton & Co.*, manufacturer of oils, chemicals and packings.

Mr. Richards comes to Detroit from Davenport, Iowa. He has been a sales representative for the firm for the past 21 years.

Magnus Names District Sales Managers

Magnus Chem. Co., Garwood, N. J., has announced the appointment of seven regional sales managers in districts ranging from Maine to Florida and as far west as Wisconsin. New managers and their districts are:

Richard J. Davis, Louisville, Ky.—the state of Kentucky and southern Indiana;

Raleigh Estrada, Chicago Heights, Ill.—the Chicago area and southeastern Wisconsin;

Alvin H. Lampp, Orlando, Fla.—the state of Florida (excluding the western panhandle), Georgia and parts of North Carolina;

Frank E. Lanaman, Cincinnati, Ohio—portions of Ohio and Indiana;

Willard F. Moore, North Syracuse, N. Y.—Upstate New York and part of Pennsylvania;

Harold R. Potts, Jr., West Hartford, Conn.—the state of Connecticut;

Alexander Simpson, Jr., Lynnfield Centre, Mass.—Boston area, coastline New Hampshire and Maine.

Richard J. Davis | Raleigh Estrada | Alvin H. Lampp | Frank E. Lanaman | Willard F. Moore | Harold R. Potts, Jr. | Alexander Simpson, Jr.

Dry Clime Lamp Corp. Appoints Representative

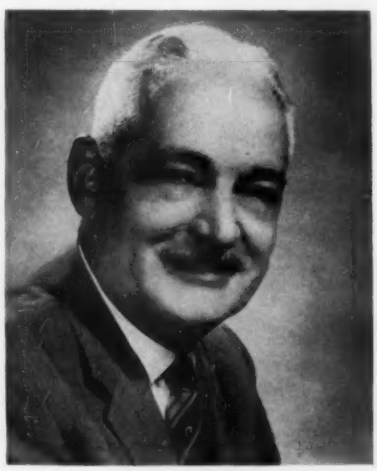
Stuart Minard

Stuart Minard, of the *New England Spray Equip. Co.*, Concord Road, Marlboro, Mass., has been appointed sales representative for the driQuik line of ceramic-type electric infra-red industrial drying ovens, manufactured by the *Dry Clime Lamp Corp.*, Greensburg, Ind. Mr. Minard, who has had extensive training in the engineering of infra-red oven applications, will offer complete free field testing service, with portable field test drying equipment brought into any plant upon request for in-plant demonstrations with the user's products and personnel.

Tect Appoints Guptill

Tect, Inc. of Northvale, N. J. has announced the appointment of *Wesley W. Guptill* as general sales manager.

Mr. Guptill has a degree in Business Administration from Dickinson College, was sales manager in the Systems Division of Remington Rand, and general sales manager with Pathe, Inc. and Thermway Industries, Inc.



Wesley W. Guptill

Chemetron Corp. Acquires Detroit Chemical Company

Chemetron Corp., of Chicago, has acquired, for cash, *Northwest Chemical Co.*, of Detroit, manufacturer of chemicals widely used in the metalworking industry. Northwest's plant and offices will remain at 9310 Roselawn, Detroit. *Harold J. McCracken*, *B. F. Lewis* and *Helen M. Morell* are the officers and founders of the firm, and will continue in charge of operations.

Northwest becomes a part of the Chemical Products Division of Chemetron.

Platronics Unveils Plating Facility

Platronics Division of *Palumbo Bros., Inc.*, unveiled what is said to

be the country's largest plating facility for electrical/electronic components, during "Open House" at their new, specially designed building, at 500 Commerce Road, Linden, N. J. The more than 300 technical and purchasing executives who attended were treated to a guided tour of the expansive production facilities, including the spacious research and development laboratory.

O.P.W. Paints, Ltd., Appoints New Technical Director

O. P. W. Paints, Ltd., principal paint division of American-Marietta Co., in Canada, announces the appointment of *James W. Sterns* as technical director in charge of new and expanded technical laboratories.

After studying chemistry at the University of Illinois, Mr. Sterns joined the firm in 1939 at their laboratory headquarters for research and development of trade sales paints in Kankakee, Ill. For over twenty years Mr. Sterns

James W. Sterns

has conducted extensive research and development on a wide variety of paints and coatings.

Conforming Matrix at New Location

Conforming Matrix Corp., manufacturer of spray masking tools and machines, has moved to new and larger facilities at 830 New York Ave., Toledo 11, Ohio. The new telephone number is RA 9-3777.

Bee Chemical Appoints District Manager

Bee Chem. Co., Lansing, Ill., has appointed *George F. Matacek* district manager of the Western Division, in Gardena, Cal.

Mr. Matacek was formerly chief chemist of the division and served for several years as a group leader in research at the company's main laboratories before the formation of the division.

George F. Matacek

Thanks for Your Christmas Cards!

At this time we would like to acknowledge and thank all those who, during the past month, have sent us Christmas cards and 1961 calendars.

Ainsley Lamps, Inc.
Albert's Plating Works, Inc.
Allied Research Products, Inc.
Amatore, Angelo
American Electroplaters' Society, Inc.
American Smelting & Refining Co.
Aurilyte Process Co.
Bakinow, Leo
Barker Brothers, Inc.
Beaver, H. Leroy
Beck, E. S.
Beresford, L. G.
Bridgham Associates
Briganti, Anthony P.
Buckeye Products Co.
Butcher Udylite de Mexico
Celanese Chemical Co.
Clinton Supply Co.
Cochrane Corp.
Conversion Chemical Corp.
Davidoff, Charles
Doyle, Edwin
Draper Ltd., Robert
Electro-Glo Co.
Electronics Plating Corp.
Errico, Anthony
Field, George C.
Foulke, Don
Fricke Co., A. C.
Gardner Laboratory, Inc.
Goldenhill, Bob
Goldwasser, Irving
Graham & Associates, Hugh H.
Hariton, Harry
Hinterleitner, Ernest J.
Jaqua Co., The
Jelco Finishing Equipment Corp.
Kellner, Dr. Henry R.
Kelly, Clyde
Kim, Yona
Kovatis, P. Peter
Lea Manufacturing Co.
Lindale Equipment & Supply Corp.
Logozzo, Arthur
Lowack, Cyril
McGean Chemical Co.
Merchants Metal Trimming Co.
Metachemical Associates, Inc.
Michigan Buff Co., Inc.
Mohler, J. B.
National Paint, Varnish & Lacquer Assn.
Nutmeg Chrome Corp.
Paint & Varnish Production
Plastic Art Metallizing Corp.
Pollack, Martin
Ramm Rectifier Co., Inc.
Reynolds Metals Co.
Schore, George
Serota, Louis
Steiger, A. J.
Stichting Galvanotechniek
Town Advertising Associates
Tyson, Inc., O. S.
Union Carbide Corp.
West Virginia Pulp & Paper Co.
Western Electric Co.
Whirlpool Corp.
Zell Products Corp.

Manufacturers' Literature

Rust Removal & Prevention

Oakite Products, Inc., Dept. MF, 118 Rector St., New York 6, N. Y.

Tested and proved procedures for preventing and removing rust under almost any conditions are detailed in Service Bulletin No. 16B, which covers such common industrial problems as the safe removal of rust from raw stock by the use of inhibitors or inhibited acid compounds; prevention of hydrogen embrittlement during rust removal by the use of alkaline derusting agents; the simultaneous removal of rust and grease while conditioning surfaces for painting; the prevention of rust between processing operations, and during periods of storage; the washing of parts by machine or tank immersion with simultaneous protection against rust; and anti-rust conditioning of steel in preparation for painting.

Rubber Products

Manhattan Rubber Div., Raybestos-Manhattan, Inc., Dept. MF, Passaic, N. J.

A completely revised new condensed general catalog, succinctly describes the company's complete line of rubber products for industry. Included in the 24-page catalog are sections on patented Poly-V drive, V-belts, transmission belt, conveyor belt, and all types of hose, flexible rubber pipe and expansion joints, plus a summary of molded and extruded products.

Automatic Loading Systems

Metal Finishing Div., Frederic B. Stevens, Inc., Dept. MF, 1800 - 18th St., Detroit 16, Mich.

A 12-page brochure devoted to automatic loading systems, as they are used in conjunction with automatic barrel plating and processing equipment, contains case histories of a wide variety of automatic loading operations. It features detailed engineering drawings and on-the-job photographs of existing installations.

Copper Etch for Printed Circuits

MacDermid, Inc., Dept. MF, Waterbury, Conn.

Metex Circuit Etch B, a new liquid chromate-type material for stripping (etch removal) copper from printed circuits is fully described in Technical Data Sheet No. 115, a three-page usage and instruction sheet.

Centrifugal Pumps

Industrial Filter & Pump Mfg. Co., Dept. MF, 5900 Ogden Ave., Cicero, Ill.

Bulletin 301 gives specification and dimension data on 8 sizes of centrifugal pumps. It outlines materials of construction and linings available for corrosion service, performance curves, and typical product usage data.

Industrial Apparel

Worklon, Inc., Dept. MF, 253 W. 28th St., New York 1, N. Y.

The above manufacturer's 1961 catalog on special purpose industrial apparel is now available, featuring new job-oriented styles for men and women in coveralls, lab coats, shirts, trousers, dresses, slack sets, and caps.

Infra-Red Ovens

Cleveland Process Co., Dept. MF, 1773 E. 21 St., Cleveland 14, Ohio.

A new, multicolor, eight page folder on fused quartz radiant ovens is illustrated with photos of "on the job" applications as well as line drawings, graphs and charts.

A comprehensive price list is in-

cluded, enabling the buyer to order any model with the correct specifications to meet his requirements. One page deals with all the various applications of the ovens. Other pages are devoted to performance data, wave lengths for proper energy distribution, etc.

Electrostatic Paint Systems

Ionic Electrostatic Corp., Dept. MF, 111 Monroe St., Garfield, N. J.

A new 8-page, illustrated catalog describes centrifugal type electrostatic paint spray systems and equipment. Bulletin 100 explains the limitations of conventional electrostatic spray equipment; then discusses the technique of atomization by air and centrifugal force, and the subsequent use of electrostatics to charge and guide pre-atomized particles of coating material.

After a preliminary discussion of electrostatic spray methods, the catalog presents the manufacturer's line of stationary and portable equipment. Power supplies and accessory equipment are also included.

Ultrasonic Cleaning Units

Acoustica Associates, Inc., Dept. MF, 10400 Aviation Boulevard, Los Angeles 45, Calif.

A new bulletin describes the above manufacturer's 40-KC line of ultrasonic cleaning systems.

Abrasive Blasting

Pangborn Corp., Dept. MF, Hagerstown, Md.

A new 12-page bulletin, No. 805, describes the push-button controlled LK and LM Rotoblast Table-Rooms designed to blast clean various-sized pieces ranging from small parts to castings or weldments up to 10 feet wide weighing as much as six tons.

In addition to photographs and cutaway diagrams, the bulletin gives complete dimensions and specifications of eight table-rooms, including the new "twin-table" type, showing how each may be tailored to particular requirements.

pH Meters

Scientific and Process Instruments Div., Beckman Instruments, Inc., Dept. MF, 2500 Fullerton Road, Fullerton, Calif.

Model N pH meters are described in a new bulletin, 720-C.

Porcelain-Enameled Aluminum

Reynolds Metals Co., Dept. MF, Richmond 18, Va.

A booklet "Questions and Answers About Porcelain Enameled Aluminum" is available from the above company.

Electric Heaters

Edwin L. Wiegand Co., Dept. MF, 7500 Thomas Blvd., Pittsburgh 8, Pa.

As an appendix to the current Chromalox industrial electric heating catalog, No. 60, catalog supplement CS-600 contains specifications and product illustrations of electric heater bands, air heating elements, blower-type heaters, immersion units, engine heaters, mineral insulated heating cable, special radiant heaters for process and comfort heating, controls and various other elements and equipment.

Wire Cloth

Cambridge Wire Cloth Co., Dept. MF, Cambridge, Md.

Bulletin #115 describes and illustrates the various types and grades of industrial wire cloth that are available, and also contains a complete listing of trade definitions to help the reader understand the terms most frequently used in the specification of wire cloth.

Bulletin #116 describes and illustrates typical specifications of metal-mesh conveyor belts and also shows a number of actual installations.

High-Heat Aluminum Paint

Speco, Inc., Dept. MF, 7308 Associate Ave., Cleveland 9, Ohio.

A new 3-page product information bulletin for Heat-Rem H-120A aluminum high heat paint describes how it can be used for many applications previously thought "unpaintable" due to temperature limitations or severe atmospheric conditions.

Conductivity Monitors

Leeds & Northrup Co., Dept. MF, 4934 Stenton Ave., Philadelphia 44, Pa.

A 4-page data sheet, E-95(3), describes two new transistorized, continuous indicating conductivity monitors. Installation connections for conductivity measurement systems, circuit diagram, and pertinent features are described for the industrial model and portable model. Also included is a table listing available conductivity ranges and types of assemblies for automatic temperature compensation.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Convention News

Plans for the 48th annual convention of the American Electroplaters' Society to be held in Boston, June 18-23, 1961, under the chairmanship of *Louis V. Gagnon* as general chairman and assisted by *Dr. George P. Swift* as co-chairman are nearing completion.

A feature of the technical program is an all-day symposium on the finishing of light metals and their alloys.

Edmund Jevely, Chairman of the *Plant Visitations Committee*, announces that trips will be made to the following places:

Keystone Camera Co., Massachusetts Institute of Technology, Gillette Safety Razor Co., Western Electric Co., North Andover and Raytheon Manufacturing Co., Andover, Mass.

In addition there is an active ladies' program and a special children's program. The social program includes:

Sunday — Registration, Ladies Tea, and in evening the Get-Together Party.

Monday — Metal Finishing Suppliers' Association party, (Evening).

Tuesday — Pops Concert, (Evening).

Wednesday — Outing at Pilgrim Village, Plymouth, with a never-to-be forgotten Clambake.

Thursday — Banquet, (Evening).

The tentative program of technical papers is as follows:

Monday, June 19, 1961

"*William Blum Lecture.*" Subject to be announced later, speaker — *Dr. Charles Faust* with *Dr. William Blum* acting as session chairman for the first group of papers.

Louis V. Gagnon
General Chairman

"A microscopic study of chromium plating."

A series of papers on Organic Coating:

"Latest Practical Applications for Organosols as Protective Decorative Finishes"

"Overcoming Organic Finishing Problems"

"New Epoxy Primer-Acrylic Lacquer Finish System"

Tuesday, June 20, 1961

All day — Finishing of Light Metals Symposium with the following papers:

"Nickel-Chromium Plating Upon AnodizedAluminum"

"Chemical Conversion Coating for Aluminum Alloys"

"Outdoor Exposure of Anodic Coatings on Aluminum: Effect of Sealing"

"The Effect of Voltage During Anodizing of Aluminum."

"Plating on Magnesium by Electrodeposition and Chemical Reduction Methods"

"Anodizing or Conversion Coating of Magnesium"

"Chromic Acid Anodizing of Brylium" Part I

"Chromic Acid Anodizing of Beryllium" Part II.

Concluded with a forum on Finishing of Light Metals.

Wednesday, June 21, 1961

"Quality Control Study to Determine Optimum Conditions for Barrel Plating in Zinc Cyanide Solutions"

"The Practical Application of Statistics to Quality Control of Electroplated Products"

"Overcoming the Limitations of Electroforming — A Progress Report"

Dr. George P. Swift
Co-Chairman

"The Anodic Behavior of Metals in Cleaning Media-Copper and its Alloys"
"Production Nickel Plating on Molybdenum"
"Improved Adhesion of Electroless Nickel Plating on Titanium Alloys."

Thursday, June 22, 1961

"Precious Metal Plating and Solderability"
"Recent Developments in the Use of Electroplating in the Additive Method of Printed Wiring Manufacture"
"Stoichiometry of Copper Bonding Using Copper Oxide"
"Electromotive Series of Different Nickel Deposits"
"Dual Chromium Plating of Zinc Die Castings"
"Objectives in Corrosion Protection of Bright Decorative Trim and Their Implementation"
"Plating of Printed Circuits with Pyrophosphate Copper and Tin-Nickel"
"Evaluation of Solderability of Electroplated Coating"
"Producing Ultra High Frequency Electronic Parts by Electroless Copper and Precious Metal Plating of Plastics."

Rochester Branch

At the December 5th meeting *Ralph E. Pettit* of the Diversey Corp., Chicago, Ill., gave a most informative talk on metal etching. His talk, titled "Manufacture of Etched Metal Goods," was supplemented by color slides and a display of manufacturing steps and finished products. *Mr. Beebe* of Diversey assisted Mr. Pettit with the displays.

After a question and answer period a lunch was served by Mr. Pettit and Mr. Beebe through the courtesy of their firm.

During the business meeting, *Peter VanDilst* was elected secretary of the Branch. A letter of acceptance, as honorary member, from *Cecil Thornton*, was also read.

Peter VanDilst,
Secretary

British Columbia Branch

The Christmas Party was held on Friday, December 9th, at the Loughead Hotel. A delicious turkey dinner was served to the 65 members and guests.

Following the dinner, an enjoyable party and dance was held under the capable leadership of M.C. *Doug Armstrong*.

C. Schlossareck,
Secretary

Buffalo Branch

The Branch held its annual Christmas Party at the Niagara Manor, Buffalo, N. Y., on Saturday, Dec. 3, with 80 ladies & gentlemen in attendance.

Features of the evening were gifts for all the ladies, a cocktail hour from 7-8 P.M., topped off with a roast beef dinner with all the trimmings. An entertainment hour followed the dinner, starring tap dancer *Audrey Kay*, and commedienne *Helen Hanes*, under the direction of *Ray Kneeland*.

The Jay Knight Band furnished music for dancing during the remainder of the party. All members and guests had a very enjoyable time at the party and were grateful to the Chairman, *Charles Fotheringham*, and his committee of *Mel Stachura* and *Daniel Stachowiak*, for their work in presenting this fine annual Christmas doings.

R. C. Eich,
Secretary

Chicago Branch

The Branch held its monthly meeting on Friday, Dec. 9, at Petricca's Restaurant, 510 N. Western Ave. President *Matt Dassinger* brought the meeting to order at 8:00 P.M. and *Paul Glab* announced that three applications were received for membership. *Scott Modjeska* gave a report on the banquet to be held Jan. 28 at the Conrad Hilton Hotel. *Russ Haar*, *Si Gary* and *Paul Glab* are preparing a new roster of the membership for the Chicago Branch. We were all happy to hear that *Hal Gilbertson*, a grand old-timer, is recovering from a heart attack.

Dave Saporta, a member of the librarians' committee, introduced the speaker of the evening, *Dr. Ted Hurst*, whose subject was "How Psychology Can Help You Get Ahead." Mr. Hurst is director of the firm Worthington, Hurst and Associates, who work as industrial psychologists. Numerous

questions were asked and answered by Dr. Hurst.

Jack Winters will be our next speaker on Jan. 13. His subject will be "The Anode Side of the Story."

Christopher Marzano,
Publicity Chairman

Rockford Branch

In regular meeting at the Faust Hotel on Dec. 12th, the Branch heard *Don Morris* discuss "Recent Developments in Bright Nickel Plating." Mr. Morris, senior field electrochemist for Hanson - Van Winkle - Munning Co., spoke very informally on modern nickel plating practices and outlined the advantages achieved by the new nickel baths currently enjoying industry acceptance.

After discussing in detail the above aspects of the subject, he added a short talk on the use of nickel for functional or engineering purposes in place of hard chrome plating, primarily as used in electroforming and record stamping.

Branch President *Harold Ellis* announced the progress of the annual meeting plans and appointed *Al Overby* chairman of ticket sales and programs for the annual to be held at the Faust Hotel on March 11th.

St. Louis Branch

The regular monthly dinner meeting was held Wednesday night, Dec. 14th, at the York Hotel. There were 22 members and guests present for dinner and 39 for the business and educational meeting.

Frank Menniges, chairman of the banquet committee, reported a letter had been mailed to the membership giving the details of the May 6th banquet. *Andy Julius* reported the chairman of the Midwest Regional Council had sent him a letter concerning the educational session for 1962 convention. *Howard McAleer* has been selected as exposition chairman for the convention in 1964.

There was no new business, so the meeting was turned over to *Ken Robins,* who introduced *Douglas Nelson,* researcher at Monsanto Chemical Co., who talked on bright dipping of aluminum. His talk was illustrated by diagrams and sketches. A lively question and answer session followed. A rising vote of thanks was given Mr. Nelson for his enlightening speech.

The meeting adjourned at 10:00 P.M.

Ward Kelly,
Secretary

New York Branch

The last meeting of the year was called to order by President *Joseph Rembecki,* at the Statler on Dec. 16. A motion made and carried that application for membership from *Jerry Whiteley* follow regular course. Following recommendations of the board of managers, a motion made and carried to accept *Ludwig Gutnaier* and *Joseph Tribolzik* as members of the Branch. The new members were duly sworn in by President Rembecki.

All banquet committees reported progress on their work. All ladies attending the afternoon party would receive a gift at the door in addition to other prizes to lucky winners. Librarian *Martin Pollack* reported three very good speakers for the technical session. The suppliers were to host a cocktail party after the technical session, then

the banquet with a floor show and dancing for all.

Librarian Pollack took over for "Good and Welfare." The speakers of the evening were *Dr. Donald Foulke* of Sel-Rex Corp. and *Barnet Ostrow* of the Lea-Ronal Corp. They covered the history of gold plating to the present outer-space age. They also covered new methods developed in recent years due to the demand for heavier deposits required now. Both speakers, experts in their fields, received a resounding round of applause.

Fred Saras,
Recording Secretary

Newark Branch

President *John Banta* called the Dec. 16 meeting to order at 8:30 P.M. with 35 members and guests in attendance. The Branch was most fortunate in having several distinguished visitors, namely the third vice-president and past president of the National Society, *Frank Beuckman* and *George Swift*, respectively; Boston Branch President, *Hugh Foley; Jim Lindsay* from Detroit; and *Rod Leeds*, editor of *Plating* Magazine.

The reading of the minutes were dispensed with. One application for membership was received and *Walter Pike* of Hanson-Van Winkle-Munning Co. was elected to membership.

Mr. Banta called upon the following members for their reports. *Al Korbelak* reported that the Christmas Party arrangements were complete. *Mel Teets* stated that ten suppliers have joined together to arrange the cocktail party prior to the annual affair. *Cy LaManna* reported that announcement for the forthcoming electroplating course was out and that 28 applicants were registered thus far.

There being no further business, the meeting was turned over to Mr. LaManna who introduced *Arnold Craft* as the "Timely Topic" speaker. His subject was the "Analysis of Precious Metal Plating Solutions by Polarographic Methods." *Richard Bikales* of Metal & Thermit Corp. spoke on "Chromium Plating." He reviewed chrome plating in general, defining its merits and what constituted good chrome plating. Both speakers covered their subjects very well considering the time allotted. They created much interest, as attested by the numerous questions.

The meeting adjourned at 10:30 P.M. in anticipation of enjoying the Christmas Party on the following evening.

Gustav Bittrich,
Assistant Secretary

Waterbury Branch

The Branch held its regular monthly meeting at the Roger Smith Hotel on Thursday, Dec. 8. Vice-President *Louis Porretti* conducted the short business meeting, and three new members received certificates. They were *Roger Sirois, Marcy Stango* and *Norman Volle*. A discussion of the forthcoming Interim Meeting was held and action will be taken to name the Old Timer who will represent Waterbury at the "Old Timers Night" to be held in conjunction with this meeting. *Perry Sloane* gave a progress report on the program to supply experienced platers as guest teachers in local high school chemistry courses. It appears as if this service will be used by several local communities.

Clarence Foster, technical chairman,

introduced the guest speaker, *A. Korbelak* of Sel-Rex, Inc., who spoke on "Jet Age Precious Metal Plating." The talk dealt with the modern aspects of precious metal plating and Mr. Korbelak showed slides and lots of parts plated with precious metals. After the official presentation, he described some of the companies and places he visited on his trip to Australia and Japan.

F. A. Schneiders

Los Angeles Branch

The great interest in precious metal plating which the boom-like growth of the missile, electronics and printed circuits industries has created in Southern California was reflected by an attendance of more than 100 members and guests at the January 11 meeting of the Branch. The lure was a talk by *Alfred Weisberg* of Chicago, vice-president of Technic, Inc., Providence, R. I., on precious metal plating as applied to the electronics industry. Weisberg had answered an emergency appeal of Educational Chairman Don E. Baudrand when previous arrangements for a speaker went awry a few days before the meeting. A half hour question-and-answer period was conducted at the conclusion of the talk.

Branch president *Frank Virgil* appointed a three-man nominating committee vested with authority to screen and propose names of members as candidates for office for the 1961-62 term. The committee, composed of *Frank Eddy, Stuart Krentel* and *Norman McEwan,* was instructed to present a slate of nominees at the February 8 meeting, at which time additional nominations may be made from the floor. The election will be held March 8.

It was announced that Los Angeles Branch will hold its annual educational session at the Statler-Hilton Hotel, Seventh and Figueroa Streets, Los Angeles, on Saturday, April 8. The program will consist of a five-hour technical session with a minimum of three speakers, a mid-day luncheon, and a dinner dance in the evening.

Harold Smallman, now a member of San Francisco Branch, invited Southern California industry members to attend the first annual educational session of San Francisco Branch, which is to be held at the Jack Tarr Hotel, San Francisco, on Saturday, March 11.

Six new members were initiated and applications accepted from three others. New members are *M. H. Golden, H. N. Levin, Harry Rubin, Robert Mefford, Frank M. Muncheryan* and *F. H. Brandenberg.*

Dayton Branch

The Branch will hold its Fifteenth Annual Educational Session and Dinner Dance on Saturday, March 4, at the Hotel Biltmore, Dayton, Ohio. The honorary chairman of the day will be A.E.S. Supreme President *W. Andrew Wesley,* International Nickel Co., Bayonne, N. J.

Branch President *Byron A. Bowman* has appointed *Lawrence H. Hadlock* as general chairman, *Robert D. Fisher* co-chairman and the following committee chairmen: *Walter W. Anderson,* Educational; *Albert W. Wendt,* Tickets; *Jack V. Baker,* Hotel Arrangements; *John Easton,* Program & Advertising; *Robert Ruleff,* Entertainment; *John Myers,* Favors; *Duanne*

Prosser, Secretary; and *Roy Critchfield*, Publicity.

The Educational Session will start promptly at 1:15 P.M. in the Hilton Room and will feature *Dr. Hyman Chessin*, director of research, Van der Horst Corp. of America, Olean, N. Y., whose topic will be "Adhesion of Electroplated Metals"; *A. H. DuRose*, Harshaw Chem. Co., Cleveland, Ohio, speaking on "Plating—Art or Science"; and *William H. Safranek*, Battelle Memorial Institute, Columbus, Ohio, who will report on "High Temperature Properties of Electroplates." The board of managers strongly emphasize that this session is open to everyone interested and that there will be no charge or registration fee to attend this meeting.

The evening festivities will begin at 6:15 P.M. in the Junior Ballroom with a Joint Suppliers Cocktail Party, followed by the dinner to be served at 6:45 in the Main Ballroom. The price of the dinner tickets will remain at the previous cost of $7.00 per plate.

L. A. Critchfield,
Publicity Chairman

SOCIETY OF VACUUM COATERS

The fourth annual Technical Conference of the Society will be held at the Conrad Hilton Hotel in Chicago, March 1st, and 2nd. The first day will be devoted to general business and committee sessions—the second, to two concurrent technical sessions, one for functional vacuum coating, the other for decorative applications.

At a luncheon meeting, *W. Strickland* of Simpson Optical Mfg. Co., will present an up-to-date picture of European optical coating, followed by *M. A. Self* of Bee Chem. Co., speaking on present day European decorative vacuum coatings.

AMERICAN SOCIETY FOR METALS

The 12th Western Metal Congress and Exposition, to be held March 20-24 in Los Angeles, will be concentrated in the Ambassador Hotel, the Exposition in Pan-Pacific Auditorium and an adjoining spacious pavilion.

More than 100 authoritative metals engineers will deliver papers at Congress sessions held by A.S.M., Society for Nondestructive Testing, Metallurgical Society of A.I.M.E., Society of Aerospace Materials and Process Engineers, and American Society for Testing Materials. The American Welding Society has also been invited to participate. Speakers will disclose late developments for selection, testing and application of metals.

At the Exposition hundreds more technical engineers will occupy front-line or aisle-side positions in displays which represent the year's findings in metals research and development.

Congress sessions will be held mornings and afternoons on the first four days of the education period. Exposition hours are announced as:

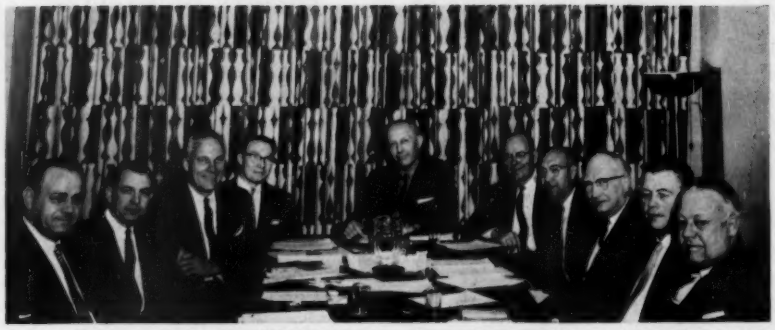
March 20-21-22: 12:00 noon to 10:00 p.m.; March 23-24: 10:00 a.m. to 6:00 p.m.

New products and processes discussed at Congress sessions and demonstrated in the Exposition will cover all types of metalworking. They will include alloying, selection, testing, application, heat treating, welding, cutting, burnishing, cleaning, grinding, and boring.

METAL FINISHING SUPPLIERS' ASSOCIATION

The officers and trustees of the Association met in Detroit on December 3 at the Statler Hilton Hotel. The meeting was called to order by President *Fred P. Green*, Crown Rheostat and Supply Co., with the following trustees present: 2nd Vice-President *H. L. Kellner*, Lea Mfg. Co.; 3rd Vice-President *R. M. Norton*, Hanson-Van Winkle-Munning Co.; Treasurer *John E. Trumbour*, METAL FINISHING; Executive Secretary *Ezra A. Blount*, Products Finishing; Trustees *J. A. Cairns*, Allied Research Products, Inc.; *E. L. Combs*, Diamond Alkali Co.; *King Ruhly*, Michigan Chrome & Chem. Co.; *J. M. Davidson*, Pennsalt Chemicals Corp.; *H. J. McCracken*, Northwest Chem. Co. *M. M. Beckwith*, chairman of the Joint-Hospitality Committee, *H. D. McLeese*, former trustee, and *Glenn Friedt, Jr.*, a representative of N.A.M.F., were also present.

One of the subjects discussed by the trustees was that of the trade survey program, currently carried on under the sponsorship of the Association. Manufacturers report to an independent agency (Price-Waterhouse) the sales of various kinds of products, and the cooperating companies receive from the agency reports of total sales of those same products. The Trustees duly noted that the Memphis-Midsouth Branch of the A.E.S. had been granted a permanent charter, and thus qualified for the M.F.S.A. *Thomas A. Trumbour Award.*



M.F.S.A. officers and trustees at Detroit meeting. Shown (left to right) are: M. M. Beckwith, Joint-Hospitality Committee chairman; J. A. Cairns, trustee; R. M. Norton, 3rd vice-president; Ezra A. Blount, executive secretary; Fred P. Green, president; John E. Trumbour, treasurer; H. L. Kellner, 2nd vice president; E. L. Combs, trustee; King Ruhly, trustee; H. J. McCracken, trustee.

Glenn Friedt, Jr., representing the National Association of Metal Finishers, discussed the interest of N.A.M.F. in promoting a public information program on metal finishing. A 3-man group from M.F.S.A. will meet with representatives from N.A.M.F. and A.E.S. to consider this matter further.

Joint-Hospitality Committee Chairman *M. M. Beckwith* reported that, for the first time, M.F.S.A. members have been advised of specific A.E.S. annual meetings where joint-hospitality functions are being planned. Thus, any member who wishes to participate, can plan his program for the entire season.

NEWS FROM CALIFORNIA

The U. S. Porcelain Enamel Co., 4731 E. 52nd Drive, Los Angeles, recently was acquired by the Norris-Thermador Corp. of Vernon, Calif., in what is reported to have been a cash-for-assets transaction.

In the past twenty years Norris-Thermador has become one of the larger manufacturing and development organizations in Southern California. In addition to a main plant at 5215 Boyle Ave., Vernon, it operates an electrical manufacturing plant in Vernon, an electronics production plant in Alhambra, and a plumbing fixture factory in Los Angeles, plus a products development laboratory. Its metal finishing facilities are among the larger such set-ups employed by manufacturer-plating concerns in the area.

U. S. Porcelain, whose annual sales reportedly exceed $2,000,000, manufactures a line of enameled street name and traffic signs, stamped steel plumbing ware and porcelain architectural panels. Its large finishing division is equipped also to do contract porcelain enameling.

Founded in 1928, the company was owned in equal shares by *A. G. Sattler*, *Albert Cesterle* and *J. L. Hodgkinson*.

Egidio Meza, general manager of Acabados Industriales, Ltda., Medellin, Colombia, recently visited California on an equipment buying trip. His firm operates the largest plating shop in Medellin, a city of a million population and second in size only to Bogota, the capital of Colombia.

The plating plant, according to Meza, is equipped to plate metal furniture, building hardware, and auto trim parts. The firm plans to expand into barrel plating. Meza's California trip was devoted to conferences with manufacturers and distributors of barrel finishing facilities and equipment for nickel, copper, zinc, and chrome barrel plating.

Kenneth C. Johnson has been named industrial division manager for the Southern California Engineering Co. in El Segundo, Calif., producers of water conditioning equipment. For the past five years Johnson has served as regional manager in Southern California for the Industrial Filter & Pump Co. of Chicago.

Anadite, Inc., South Gate, Calif., Kwik Set Locks, Inc., Anaheim, and Alcoa of Los Angeles, collaborated in designing, constructing and doing the plating and polishing of a set of golden aluminum doors for the new club house of the Greater Los Angeles Press Club.

The doors of architectural aluminum were fabricated by Alcoa and gold anodized by Anadite, Inc. Kwik-Set Locks provided and processed the lock sets. Roy E. Klutz, president of Anadite, headed a committee of the donors which recently presented the

doors to Press Club President *James McNamara* of Los Angeles.

The parts that precious metal and printed circuitry plating play in the aerospace industry were given considerable attention by both speakers and exhibits at the recent Aircraft Electrical Society Conference and Show at the Pan Pacific Auditorium in Los Angeles.

Some 15,000 space scientists, engineers and management personnel attended the conferences and inspected the more than 100 booths with exhibits of systems and products applying to the use of electronics and electricity in the aerospace industry.

Among plating displays that attracted attention were precious metal plated magnesium parts exhibited by Burton Silverplating Co. of Culver City, Calif., and Specific Plating Co. of Los Angeles.

How printed circuitry applies to the aerospace industry was related in a talk by G. W. Godfrey of North American Aviation. His talk on "Development of Printed Circuit Techniques in Air Vehicle Electrical Systems" was amplified by a display of prototype equipment assemblies.

One of the methods by which the Los Angeles Society for Coatings Technology keeps its future study topics and research projects in step with current developments in its field is to make periodic polls of the entire membership.

The most recent poll initiated by the L.A.S.C.T. technical committee requested members to send in study suggestions. Technical Committee Chairman *Don Heisler* and Secretary *George S. Cook*, in a letter to the members, pointed out that the small, incisive solution to a current problem that can be solved in a short time by an active sub-committee, may have greater immediate value to all than a program that doesn't show progress for several years.

The committee asked for suggestions on small and large problems of mutual interest in the coating field that would lend themselves to co-operative study. All suggestions are turned over to the appropriate sub-committees. As the new year began the society had active committees on color calculation, solvency of oxygenated solvents, emissivity and reflectivity of coatings, and surface area studies of pigments. President *Fred E. Oberlin*, and technical committee chairman Heisler announced that regular meetings of the committees are planned in 1961, so that interest and progress will remain at a high level.

The 1960-61 Year Book issued by the Society lists a total of 205 members, of which 80 are Class A, 28 Class B, 93 associate and 4 honorary.

Peter Colefax, Los Angeles, has been named chairman of the board of the American Potash & Chem. Corp. He will also continue to serve as president, a position he has occupied since 1947.

The 12th Western Metal Exposition and Congress will open in Los Angeles March 20 and continue through the 24th. The congress will be concentrated in the Ambassador Hotel, the exposition in the Pan Pacific Auditorium and an adjoining pavilion.

In excess of 100 authoritative metal engineers are scheduled to deliver papers at Congress sessions under sponsorship of the American Society for Metals, and collaborating groups, such as the Society for Nondestructive Testing, Metallurgical Society of A.I.M.E., Society of Aerospace Materials and Process Engineers, and American Society for Testing Materials.

Some 200 metal working firms and metal processors from all parts of America will present exhibits representing the most advanced facilities and products available for industry, in the fields of metal forming, fabrication, plating and finishing.

Congress technical sessions are free. The exposition is free to holders of A.S.M. admission - invitations which can be obtained from suppliers who are exhibiting.

Adams Rite Mfg. Co., 540 West Chevy Chase Drive, Glendale, Calif. has acquired a new plant building and grounds adjoining its present location. Completely remodeled, the new building adds 10,000 square feet to the facilities and brings the firm's production area to a total of 100,000 square feet.

The building has been designed to mechanize the metal forming, plating, polishing, and general manufacturing processes required in the production of architectural hardware. A new engineering department is included.

Micro-Dot Mfg. Co., South Pasadena, Calif., has installed a precious metal plating department for use in plating electronic components parts, connectors and similar items. Silver

plating facilities have already been installed, and are expected to be supplemented by gold solution tanks later.

Carlyle L. Helber recently joined the technical staff of Autonetics, Inc., a division of North American Aviation, Inc., as a research engineer in the firm's Compton, Calif. plant. He was formerly active in a similar capacity for McDonnel Aircraft Co. in St. Louis, Mo.

Anchor Plating Co., formerly located in the Rush St. industrial area of El Monte, Calif., has moved into a new plant on Tyler St., same city. The new shop is equipped with facilities for plating gold on magnesium, fused tin on electronic parts, cadmium, silver, and rhodium.

NEW BOOK

A Practical Manual of Industrial Finishes

By B. M. Letsky. Published in 1960 by Reinhold Publishing Corporation, New York and by Chapman & Hall, Ltd., London. U. S. price — $8.00.

This 250-page volume, published last year in England, is divided into two main parts. The first part deals with finishes for wood and the second part with finishes for metal and other miscellaneous substrates. Forty figures illustrate the text.

In the portion of the book dealing with wood finishes, actual formulas are given for stains, sealers, lacquers, etc. and the finishing operation is described in great detail. Not only is the age-old story of French polishing carefully told, but the author also covers the newer polyester, polyisocyanate and other similar finishes for wood. Application by roller coating, curtain coating, as well as by spraying is carefully outlined. Plant layout and finishing schedules are covered in a special chapter. Defects in wood finishing are defined and remedies suggested.

Finishing metal with organic coatings is equally well described. Metal phosphating is properly emphasized as are also epoxy, vinyl, phenolic and other modern finishes. Numerous formulations are detailed. The chapter on application methods includes a description of dipping, flow-coating, tumbling, and roller coating, as well as miscellaneous spraying methods. The application and usage of special finishes such as lacquers for plastics; wrinkle, crackle, pebble, pearl, flock and other specialized coatings are described and formulas are given in many cases. The plant layout section includes flow sheets.

Quality control testing is covered in both parts of the book. The practical approach given to this topic is evident from the author's statement that "the experienced and intelligent observer is the first essential" and the "estimate by an experienced thumb is never more than 10% from the mark."

Though written for a British user, we believe this book has much to recommend it to an American student of the processes of finishing.

Mar. 1-2: Technical Conference, Society of Vacuum Coaters, Conrad Hilton Hotel, Chicago, Ill.

Mar. 3-4: Annual Technical Session and Banquet, Philadelphia Branch A.E.S., Benjamin Franklin Hotel, Philadelphia, Pa.

Mar. 4: 15th Annual Educational Session, Dayton Branch A.E.S., Biltmore Hotel, Dayton, Ohio.

Mar. 20-24: 12th Western Metal Congress and Exposition, American Society for Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

Apr. 30-May 4: Spring Meeting, The Electrochemical Society, Claypool Hotel, Indianapolis, Ind.

May 5-6: Empire State Regional Annual Meeting, concurrent with Rochester Branch A.E.S. 50th Anniversary Celebration, Hotel Manger, Rochester, N. Y.

May 8-11: 1st International Industrial Finishes Exhibition, Earls Court, London S.W. 5, Eng.

Apr. 22: 22nd Annual New England Regional Meeting, A.E.S., Hotel Statler, Hartford, Conn.

June 18-23: 48th Annual Convention, A.E.S., Boston Host Branch, Boston, Mass.

Sept. 5-8: 11th National Chemical Exposition, Chicago Amphitheater, Chicago, Ill.

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750/375	6/12	Excell-All
845	47.3	Elec. Prod.
940	32	Elec. Prod.
1000/500	6/12	Eager
1000/500	12/24	H-V-W
1500	15	Star
1500	30/50	Century
1500	40/85	G. E.
1500	65	Westinghouse
1500	70	Century
2000	6	Eager
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6000/3000	6/12	Elec. Prod.
6000/3000	12/24	Chandeysson

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FOR SALE

18,000 sections used spiral sewed buffs. ¼" and ⅜" sewing, 1¼" arbor hole, 9" to 10" in diameter, 16¢ each. Address: February 2, care Metal Finishing, 381 Broadway, Westwood, N. J.

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1—4000 Amp. plating generator, 9 volts, speed 600, 36 KW. Manufactured by Chandeysson Electric Co. Motor 60 HP, 440 volts.

These units are in excellent condition — a bargain. Address: February 3, care Metal Finishing, 381 Broadway, Westwood, N. J.

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Stevens "A" 38' long for electropolishing cycle; clean, rinse, acid, rinse, electropolish, rinse, acid, rinse, force dry. Machine recently rebuilt. In excellent condition, can be converted to chrome or like process. See in operation at your convenience. Address: February 6, care Metal Finishing, 381 Broadway, Westwood, N. J.

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SITUATIONS OPEN — Distributors needed in several territories on cadmium and zinc plating brighteners and plating specialties. Advertising referrals and excellent discount. Address: February 4, care Metal Finishing, 381 Broadway, Westwood, N. J.

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SITUATION OPEN—Job shop plating foreman. Must be experienced in copper, nickel and chrome on small parts, still and automatic. Must be qualified to supervise department and help solve plating problems. Willing, hard worker. Excellent opportunity for advancement. New York area. Address: October 11, care Metal Finishing, 381 Broadway, Westwood, N. J.

PLATING SUPERVISOR

SITUATION OPEN—Plating specialist, qualified in Production Engineering. Thoroughly experienced in copper, nickel, chrome, silver and gold — barrel, rack and automatic plating of small parts. Trouble shooting, maintenance and handling personnel. Strong working background methods and cost reduction knowledge and rack designing. B. S. degree in chemistry desirable. Permanent opportunity. Long established job shop in New York area. $9,000 start. Address: October 10, care Metal Finishing, 381 Broadway, Westwood, N. J.

SITUATION WANTED

SALESMAN

SITUATION WANTED—Age 40. Have had twenty years' experience in all types of job plating, laying out of complete coloring plants, have knowledge of all types rectifiers, and chemicals. Would like position as salesman for New England area for chemical house dealing with equipment and plating materials. Have had experience selling locally. Address: February 5, care Metal Finishing, 381 Broadway, Westwood, N. J.

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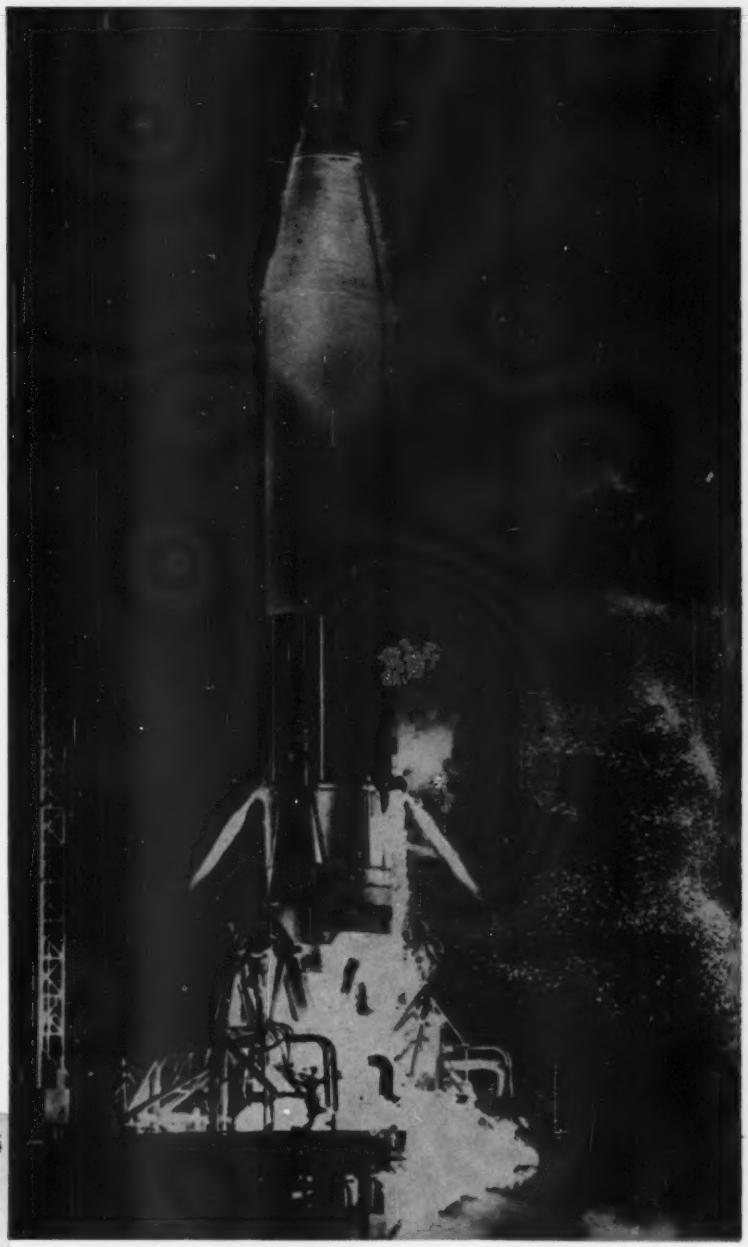

The failure of a single component can put even the mighty Atlas Missile out of commission. That's why an electroplate of SEL-REX BRIGHT GOLD is specified to give an extra measure of reliability to Elco's patented VARICON Contacts used in missiles, rockets, computers and similar critical applications.

The VARICON Contact, with its fork-like design and 4 coined mating surfaces, offers exceptional resistance to numerous punishing insertions and withdrawals—meeting or surpassing the most exacting specifications. Patented SEL-REX BRIGHT GOLD, which produces a fine grained, dense electroplate—twice as hard as conventional 24K Gold plate — is a major reason for the reputation of quality and reliability enjoyed by VARICON throughout all industry.

SEL-REX makes the world's largest selection of processes and systems which take the guesswork out of plating with precious metals. Baths are simply maintained with scientific precision by additions of pre-measured salts or solutions. Your assurance of consistent quality results from one batch to the next.

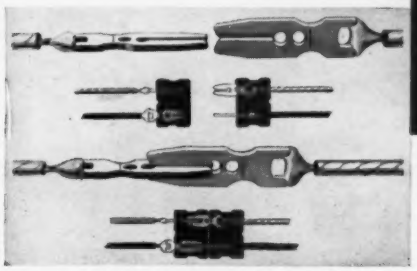

Photo shows Elco's patented Varicon Connectors and unique fork-like contact plated with Sel-Rex Bright Gold.

An internationally based network of sales and service technicians is at your beck and call to make sure you get the optimum results built into every SEL-REX PROCESS.

Complete technical literature free on request. Specify precious metal(s) and your application.

*Patented

Patented processes for plating with Gold, Rhodium, Platinum, Paladium, Silver, and to produce "custom alloys" for your particular requirements.

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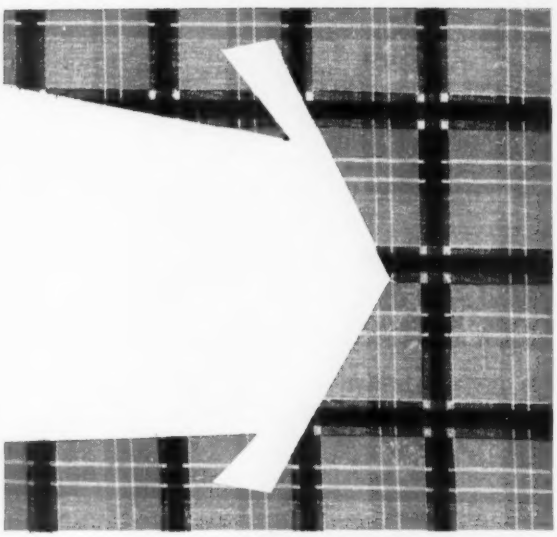
The World's Largest Selling Precious Metal Plating Processes

Now strip nickel and copper (copper-plated, zinc base die castings, too) this new, low-cost way!

Parts dimensions stay unchanged . . . even after several hours in solution!



Metex nickel stripper BR

Surface finish unaffected . . . buffing eliminated or greatly reduced!

Dry powder form for easier handling . . . strips by immersion to reduce costs!

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